Message

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Sent: 5/15/2017 9:08:24 PM
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Subject: Agenda for the 5/16/17 Drinking Water Enforcement Call

Attachments: FINAL Safe Drinking Water Report 17-02-A_hr08 ALLsmall[1].pdf

Hi all,

Below is the draft agenda for tomorrow's (5/16) drinking water enforcement call.

Agenda:

- ETT correction related to some GWR violations
- Sanitary survey training scheduled for the week of May 22
- Annual state program oversight
- Corrective action for recommendation no. 5 in OIG's 2016 Small PWS Noncompliance Report
- May 19 House Energy and Commerce Committee hearing about possible SDWA amendments promoting water system partnerships
- GAO elevated lead in drinking water draft report expected soon
- NRDC's May 2 drinking water report (attached)

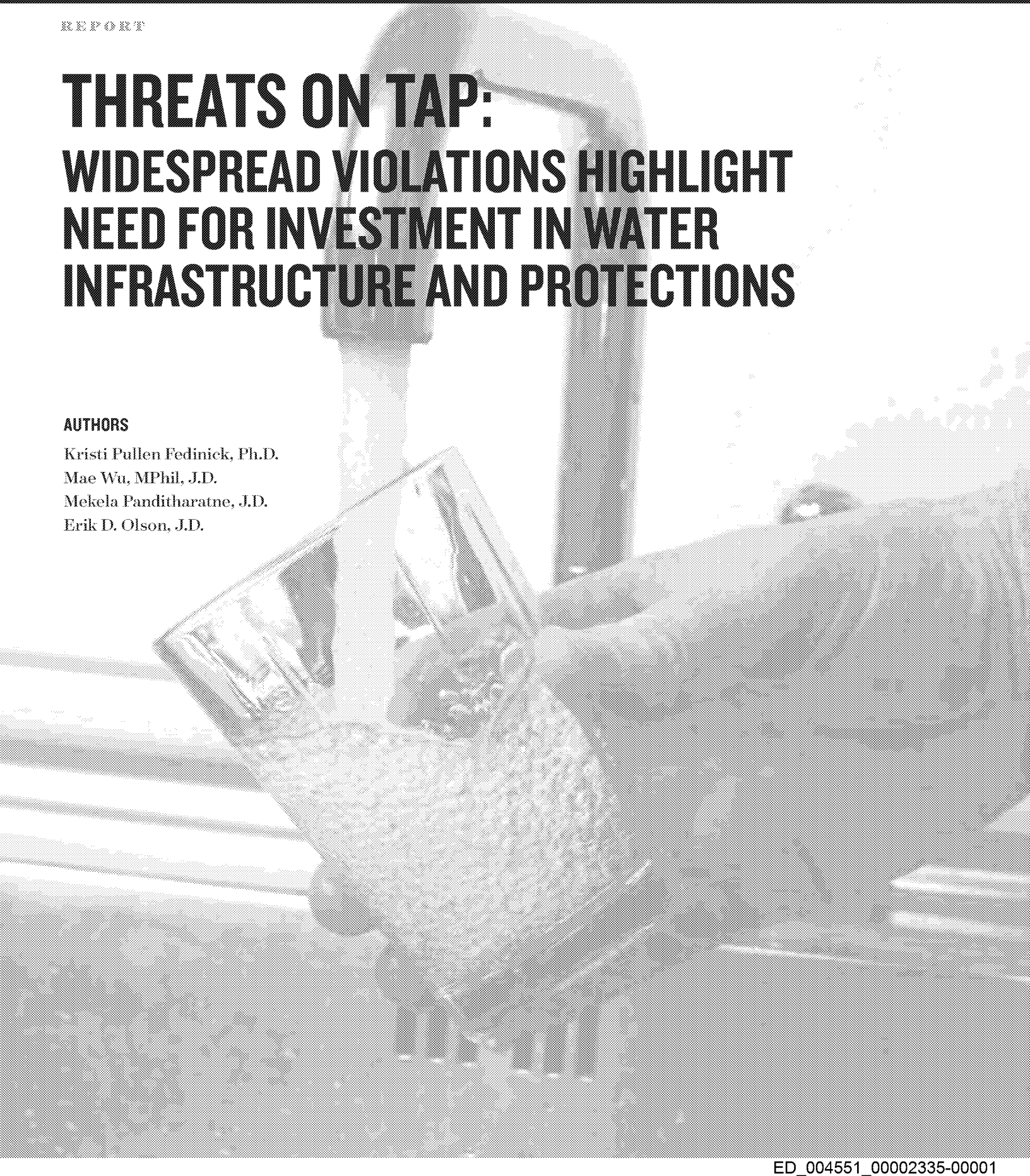
FINAL Safe Drinking Water R...

NRDC

MAY 2017
R:17-02-A

REPORT

THREATS ON TAP:
WIDESPREAD VIOLATIONS HIGHLIGHT NEED FOR INVESTMENT IN WATER INFRASTRUCTURE AND PROTECTIONS



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About NRDC

The Natural Resources Defense Council is an international nonprofit environmental organization with more than 2.4 million members and online activists. Since 1970, our lawyers, scientists, and other environmental specialists have worked to protect the world's natural resources, public health, and the environment. NRDC has offices in New York City, Washington, D.C., Los Angeles, San Francisco, Chicago, Montana, and Beijing. Visit us at nrdc.org.

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Executive Summary

The Safe Drinking Water Act (SDWA), one of our bedrock environmental laws, established the role of government in providing safe, clean drinking water. Instituted in 1974, the SDWA requires the U.S. Environmental Protection Agency (EPA) to identify and regulate contaminants to ensure drinking water quality. States then are generally the primary enforcers of the law, subject to EPA oversight. These requirements are meant to protect us from serious health impacts—cholera outbreaks, lead poisoning, and even cancer. But the EPA and the states have been falling short. For more than 25 years, NRDC has been documenting serious problems with our outdated and deteriorating water infrastructure and the inadequate implementation of the Safe Drinking Water Act.[1] These problems include poor EPA and state enforcement, serious underreporting of violations, and weaknesses in the EPA's drinking water standards for contaminants like arsenic and lead.[2]

For more than 25 years, NRDC has been documenting serious problems with our outdated and deteriorating water infrastructure and the inadequate implementation of the Safe Drinking Water Act.

In 2015, the heartbreaking lead emergency in the city of Flint, Michigan, captured national attention, causing public uproar and spurring local mobilization. In 2016, NRDC teamed up with the American Civil Liberties Union of Michigan (ACLU-MI) to represent the community in court as Flint's residents fought for access to clean drinking water. Our analysis of EPA data revealed that, sadly, Flint was far from alone.[3] We found that in 2015, more than 18 million people were served by community water systems that had violated the Lead and Copper Rule, one of the EPA regulations issued to carry out the SDWA.[a]

This report expands our analysis beyond lead to examine all drinking water contaminants regulated under the SDWA. Much as Flint is not the only water system with lead problems, we have found that Lead and Copper Rule problems are far from the only widespread violations of drinking water rules. Our research shows that in 2015 alone, nearly 77 million people were served by more than 18,000 community water systems[b] that violated at least one SDWA rule, and there were more than 80,000 violations of SDWA rules that year. These violations included exceeding health-based standards, failing to properly test water for contaminants, and failing to report contamination to state authorities or the public.

Further analysis of the violations of health-based standards showed that in 2015, there were more than 12,000 health-based violations in some 5,000 community water systems serving more than 27 million people. In other words, these drinking water systems violated the parts of the rules that set health-protective standards that stipulate permissible levels for each contaminant or require treatments to reduce health threats.

Troublingly, we also found that systems serving very small communities—such as rural and more sparsely populated areas—had a significantly higher rate of violations of the health standards and a higher percentage of total violations compared with larger systems. Systems serving less than 500 people accounted for nearly 70 percent of all violations and a little over half of all health-based violations. This means that rural Americans could be at greatest risk from some drinking water contaminants.

These violations—combined with shortcomings in the EPA's rules, lackluster enforcement, and the aging drinking water treatment and distribution infrastructure—have very real public health consequences. In fact, the Centers for Disease Control and Prevention (CDC) says that approximately 19.5 million Americans fall ill every year from pathogens as a result of contaminated drinking water from public water systems. The young, the elderly, and immunocompromised individuals are particularly vulnerable.[4] And that's just the microbiological waterborne illnesses like cryptosporidiosis and Legionnaires' disease. No comprehensive estimates have been published of the number of cancers, reproductive and neurological diseases, or other serious chronic health problems caused by contaminated tap water.

Fixing the infrastructure problems that cause these violations can save lives, reduce the occurrence of disease, and create hundreds of thousands of jobs in communities that need them most.

a Primary drinking water regulations cover contaminants that may have an adverse effect on people's health. They either establish specific limits for how much of a contaminant can be found in water or establish a specific treatment technique that will reduce the level of the contaminant in the drinking water. 42 U.S.C. § 300f(1).

b The Safe Drinking Water Act defines a community water system as a public drinking water system that "serves at least 15 service connections used by year-round residents" or "regularly serves at least 25 year-round residents." 42 U.S.C. § 300f(15). This definition is in contrast to the broader term "public water system," which includes community water systems as well as noncommunity water systems that do not serve people year-round.

FIGURE 1: 76.9 MILLION PEOPLE SERVED BY COMMUNITY WATER SYSTEMS WITH AT LEAST ONE REPORTED VIOLATION OF THE SAFE DRINKING WATER ACT (2015). POPULATIONS ARE SHADED AT THE COUNTY LEVEL TO SHOW THE NUMBER OF RESIDENTS SERVED BY COMMUNITY WATER SYSTEMS WITH VIOLATION(S) IN 2015.

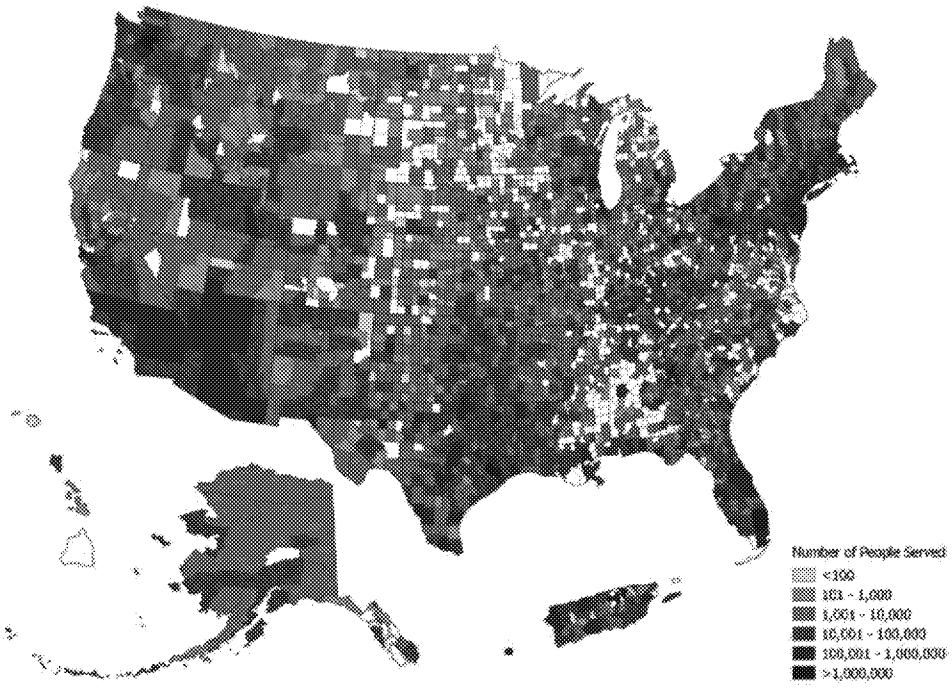
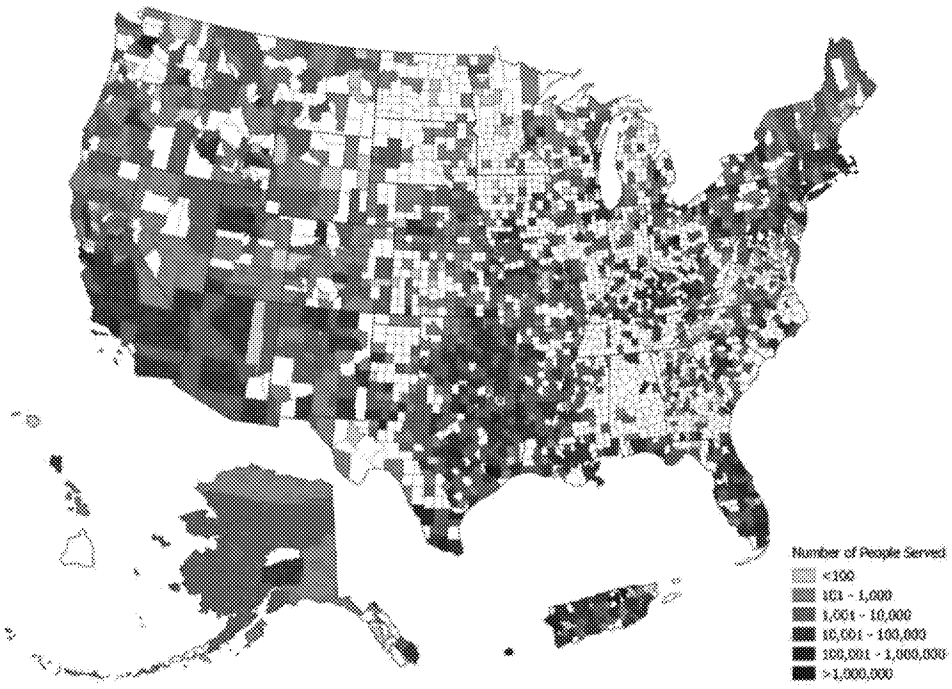


FIGURE 2: 27.4 MILLION PEOPLE SERVED BY COMMUNITY WATER SYSTEMS WITH AT LEAST ONE REPORTED HEALTH-BASED VIOLATION OF THE SAFE DRINKING WATER ACT (2015). POPULATIONS ARE SHADED AT THE COUNTY LEVEL TO SHOW THE NUMBER OF RESIDENTS SERVED BY COMMUNITY WATER SYSTEMS WITH VIOLATION(S) IN 2015.



THE SAFE DRINKING WATER ACT: HOW IT WORKS . . . AND HOW IT DOESN'T

Under the SDWA, the EPA must identify hazardous drinking water contaminants—from arsenic to xylene—and develop rules that either set maximum permissible levels for them or establish protocols to treat the contaminated water to minimize the levels of the contaminant. These drinking water rules cover around 100 contaminants such as toxic chemicals, microorganisms, radioactive elements, and metals that can cause health impacts like cancer, birth defects, miscarriages, and cognitive impairment.[c]

The SDWA requires the EPA to review its regulations every six years and to strengthen them as the science advances. And right now, many rules need to be made more stringent. For example, the Flint crisis highlighted weaknesses in the Lead and Copper Rule. Although Flint residents had extraordinarily high levels of lead in their water, the city's water system had no reported violations of that rule. Problems with how, where, and when drinking water samples were taken and reported resulted in the presence of very high levels of lead in the tap water without any official report of a violation. Weaknesses in the current Lead and Copper Rule, and numerous deficiencies in other EPA drinking water rules, require strengthening changes for the sake of public health.

Since 1996, the EPA has not set a single new standard for a drinking water contaminant under the SDWA's provisions for establishing such standards.

Beyond the regulated contaminants, many more are found in drinking water but are not regulated. Since 1996, the EPA has not set a single new standard for a drinking water contaminant under the SDWA's provisions for establishing such standards. In those 20 years, the EPA has decided that only one new contaminant should be regulated—perchlorate (a component of rocket fuel). But since that initial decision six years ago, the agency has not actually proposed any standard.[5] In addition to perchlorate, many other unregulated drinking water contaminants are ripe for EPA regulation, like algal toxins (from hazardous blooms of algae), the widespread Teflon-related toxic chemicals PFOA and PFOS, the carcinogen hexavalent chromium, and the pathogen Legionella (which causes Legionnaire's disease).

Unfortunately, some lawmakers on Capitol Hill are working to make it more difficult—if not impossible—for the EPA and other agencies to set new rules and strengthen the existing ones. The House of Representatives passed the Regulatory Accountability Act (see sidebar) and other, similar legislation in January 2017 that tilts the regulatory system in favor of industry interests and erects new barriers (some of which are insurmountable) to developing rules to protect health and safety. If this legislation passes in the Senate and is enacted, drinking water regulations will stagnate and the public will be at risk from drinking water contamination.

The **Regulatory Accountability Act** (RAA) would make it harder to create regulations to protect the public—like the regulations establishing standards for contaminants under the Safe Drinking Water Act. The bill would create new barriers to developing regulations and could make them impossible to uphold in court. The bill also would require agencies to consider factors other than impacts on human health when setting health standards.

The RAA would harm health protections, like the rules promulgated under the Safe Drinking Water Act, in the following ways:

- Current health statutes require some health standards to be based on science and the limits of feasible technologies. The RAA would amend current law to overturn this requirement, elevating costs to industry over ensuring health protection.
- The bill would give industry interests more power to delay and complicate rulemakings under the Safe Drinking Water Act. It would require the EPA (and other agencies) to analyze "any substantial alternatives" submitted to them by opponents of the rule. Industry could also petition for time-consuming hearings on proposed rules for unregulated contaminants, and it would be difficult for the EPA to reject those petitions.
- The RAA requires agencies to adopt the "least costly rule" even if that is not the most health-protective. The language could also make it impossible for a court to uphold a rule because the language effectively makes an agency review an almost unlimited number of alternatives to show a rule is the "least costly."
- The bill could sidetrack the EPA with new and unnecessary analytic tasks, many of which are purposely beyond the ability of economists to complete or satisfy. These hurdles are in addition to the already existing plethora of laws and executive orders that require substantial analysis.
- The RAA would prevent high-cost public protections, such as regulations under the Safe Drinking Act, from moving ahead until all actions seeking judicial review of the public protection are decided.
- The bill creates a catch-22 that could prevent rulemakings from ever being completed. It imposes additional, time-consuming requirements but then says a rulemaking has to begin all over again if it lasts more than two years. This also creates an incentive for industry to drag out rulemakings to restart the clock repeatedly.

c The Safe Drinking Water Act became law in 1974. Refer to Appendixes 1–12 for further descriptions of these 12 rules.

MONITORING AND REPORTING VIOLATIONS MAY BE MASKING SERIOUS HEALTH RISKS

Across the country, the tens of thousands of monitoring and reporting violations could be hiding more health threats. Nearly 25 years ago, NRDC first documented underreporting problems in the EPA's drinking water database.[6] More recently, in a 2013 report, the EPA admitted that "audits and assessments have shown that violation data are substantially incomplete."[7]

There are many ways public water systems can violate SDWA rules, including violating health-based standards, improperly treating water, or failing to monitor and report violations to the state or to their customers. Violations of health-based standards are especially concerning because they mean the water system has exceeded permissible levels or has not applied required treatment. But violating the rules' monitoring and reporting requirements can also pose serious health risks by masking a potentially dangerous situation.

Sometimes, public water systems fail to properly sample their water so health-based violations are not discovered. In other cases, states fail to correctly document violations. States also sometimes fail to report known violations to the EPA's database as required by federal law. These kinds of monitoring and reporting failures can hide serious health threats. In one stark example, as of January 2017, Flint actually had no reported violations of the Lead and Copper Rule (though NRDC strongly believes Flint was in violation of that rule).[8] Given these failures, it is likely that the widespread violations documented and mapped in this report reflect only a subset of a serious problem.

ARE THE STATES ASLEEP AT THE SWITCH?

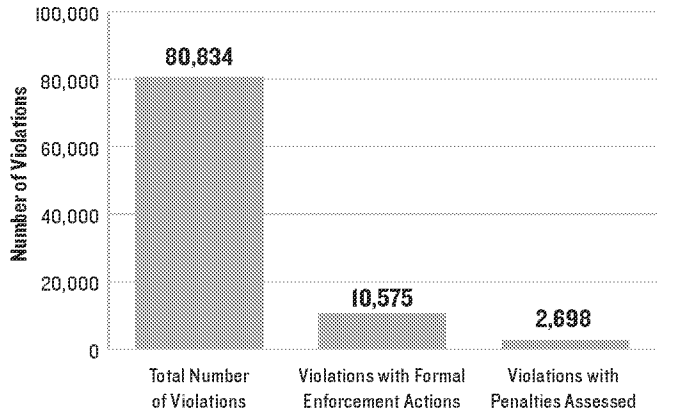
Under the SDWA, the EPA is ultimately responsible for setting and enforcing rules for all public water systems.[d] However, the act allows states and Native American tribes to apply for primary enforcement responsibility, or "primacy," which grants them substantial federal funding and imposes legal obligations. The EPA grants primacy if the state or tribe's regulations are at least as stringent as the EPA's own rules, and if it has demonstrated the authority to adequately compel compliance. Public water systems are required to report results from sampling and report violations to state authorities, which then relay the information to the EPA. The state takes the lead in bringing noncompliant systems back into compliance, while the EPA acts as a backup if the state fails to resolve violations. This system of self-reporting relies heavily on the honor code, blowing the margin for error wide open. Past EPA audits have found widespread underreporting of violations.

NEARLY 9 IN 10 DRINKING WATER VIOLATIONS WERE NOT SUBJECT TO FORMAL ENFORCEMENT

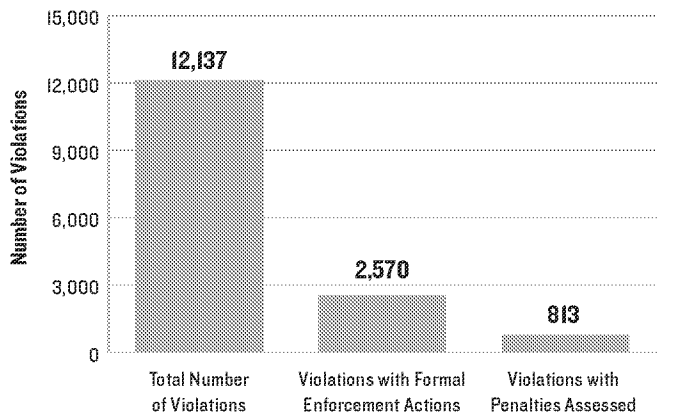
Even when violations are known, they're not necessarily corrected. According to the EPA's Safe Drinking Water Information System (SDWIS) data, of the more than 80,000 reported violations that occurred in 2015, the agency and states took formal enforcement action against a mere 13.1 percent.[9] Nearly 9 out of 10 violations were subject to no formal action by the state or the EPA, such as the issuance of a notice of violation, a site visit, or the filing of a civil or criminal filing of a civil or criminal action. Even fewer of those reported violations—an abysmal 3.3 percent—received penalties.

Health-based violations barely fared better. Agencies took formal enforcement actions against 21.2 percent of health-based violations. Furthermore, penalties (either criminal punishment or civil fines) were sought or assessed for only a tiny fraction (6.7 percent) of violations.[e]

FORMAL ENFORCEMENT ACTIONS FOR VIOLATIONS OF THE SAFE DRINKING WATER ACT



FORMAL ENFORCMENT ACTIONS FOR HEALTH-BASED VIOLATIONS OF THE SAFE DRINKING WATER ACT



d A public water system is defined by the Safe Drinking Water Act as a system that provides water for human consumption "that has at least 15 service connections or regularly serves at least 25 individuals." 42 U.S.C. §300f(4)(A). Systems that service fewer people, and people who receive water from private wells, are not covered by the Safe Drinking Water Act.

e It should be noted that often states (or in rare cases the EPA) will take what they call "informal enforcement" actions, such as sending a letter or calling an offending water system. According to NRDC analysis of EPA data, in 86.0 percent of all violations in 2015 and in 95.4 percent of health-based violations, at least an informal action such as a call or letter occurred. However, in thousands of cases not even informal action was taken. Importantly, as is discussed above, such "informal" actions often failed to bring systems back into compliance, and the lack of formal enforcement sends a clear signal that breaking the law is unlikely to result in meaningful enforcement or penalties. 42 U.S.C. §300g-3.

Nearly 9 out of 10 violations were subject to no formal action by the state or the EPA.... Even fewer of those reported violations—an abysmal 3.3 percent—received penalties.

This lack of accountability tells water systems that are knowingly violating the SDWA, with state and federal complicity, that their wrongdoing will go unpunished. The data highlight the need for a culture change at the EPA and state regulatory bodies to ensure that violations are taken seriously and that public health threats are addressed promptly.

WHAT NOW? INVEST IN AND IMPROVE INFRASTRUCTURE AND ENFORCE THE LAW

While the problem is vast, there are solutions. And those solutions could even solve other problems at the same time.

1. Improve water infrastructure and modernize our drinking water treatment plants.

The widespread SDWA violations are too often caused by deteriorating and outdated water collection, treatment, and distribution infrastructure. Every year, there are approximately 240,000 water main breaks due to old, often poorly maintained water lines that have outlived their useful lives.[10] There are also 6 million to 10 million service lines across the country that are at least partly made of lead.[11] In many communities, the outdated treatment plants that are supposed to purify our tap water continue to rely on century-old technologies that simply cannot remove many of today's toxic chemicals and pathogens.[12] Sewage collection and treatment facilities, too, often cannot get rid of dangerous microbes and toxic chemicals. Instead they discharge raw or poorly treated sewage into our drinking water sources. This is especially frequent after rain events, which can overload outdated systems.

These fundamental components of our water infrastructure need major upgrades. Lead service lines need to be fully replaced. Drinking water facilities need to be updated with modern water treatment technologies. Leaking pipes and deteriorating mains need to be fixed or replaced. Nineteenth- and early 20th-century sewer systems in cities across the country must be modernized to be able to absorb excess water from extreme rain events, which are becoming more frequent. Implementing these fixes not only will improve public health, but could also create millions of jobs across the country.

2. Increase funding for water infrastructure to protect health and create good jobs.

There are almost a trillion dollars' worth of upgrade and maintenance projects across the country for drinking water infrastructure. Paying for these projects will be no small feat. Under the SDWA, the Drinking Water State Revolving Fund (DWSRF) allocates congressional funds for utilities to use to achieve or maintain SDWA compliance.[13] The fund also supports source water protection and operator certification. States are authorized to distribute DWSRF resources in the form of low- and no-interest loans, grants (in limited cases), and other types of financial assistance. States are responsible for matching a percentage of DWSRF allocations. From 1998 to 2016, the federal government invested about $19 billion in the DWSRF, which has translated to more than $32.5 billion in total allocations to water system projects across the United States.[14]

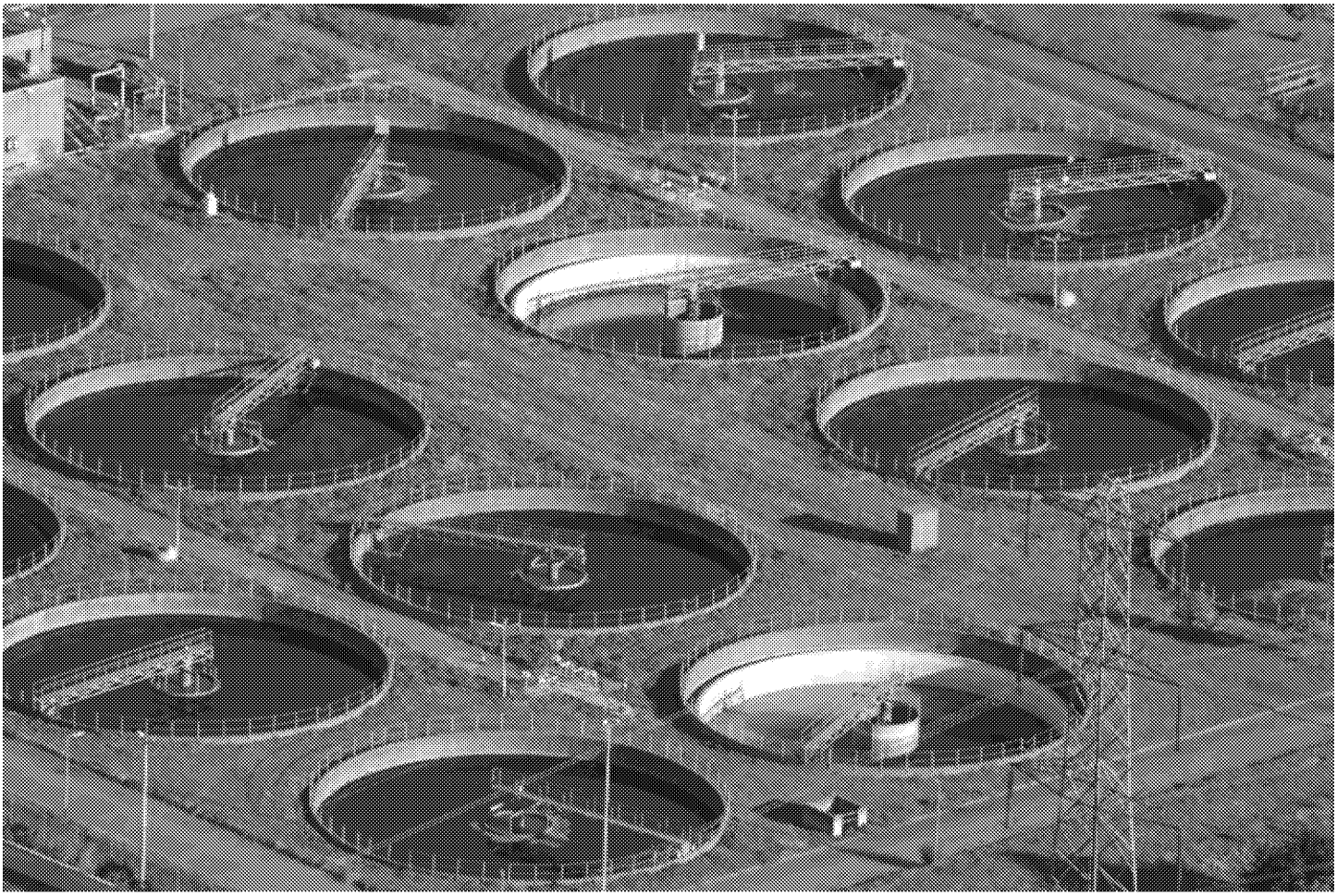
This investment, while helpful, is significantly less than we need it to be. Congress must increase funding for drinking water infrastructure to at least $8 billion per year, roughly triple the current amount of $2.3 billion. Fortunately, during his campaign, President Trump outlined a vision for the future of infrastructure that promised to do just that.[15] In the bipartisan Water Resources Development Act, the U.S. Senate noted that for every $1 million in state revolving loan fund spending, 16.5 jobs were created.[16] It further observed that $34.7 billion in federal capitalization grants for the DWSRF would create 506,000 jobs.[17] These investments can create millions of well-paid jobs in construction, steel mills, and other trades all over the country.[18]

3. Strengthen existing regulations and establish new ones.

Current SDWA rules such as the Lead and Copper Rule have weaknesses that leave many people's drinking water susceptible to contamination. In addition, many contaminants found in drinking water are not regulated. The EPA must establish rules for many of these unregulated contaminants—starting with a health-based standard for perchlorate, as EPA formally promised to do six years ago. Congress must not hinder the EPA's ability to improve existing regulations or to promulgate new ones. Congress must not pass the Regulatory Accountability Act or similar legislation, which would harm public health and leave everyone with potentially unsafe drinking water.

4. Develop a more robust testing system for drinking water contaminants.

We need a monitoring program that can quickly and accurately identify problems in a drinking water system. The EPA should strengthen its rules to require more frequent—and more targeted—testing. In the absence of federal action, states and public water systems can also implement their own stronger monitoring programs that include things like required lead testing at schools and day care facilities. Finally, more research into and development



of sensors and other methods to continuously test for contaminants at the tap would empower citizens to check the quality of their drinking water, rather than relying on public water systems to do so.

5. Strengthen all drinking water enforcement mechanisms. The EPA and the states should make SDWA compliance a top priority. Substantially increased funding for implementation, investigation, and enforcement is critical, as is funding for audits of water system records and state files to ensure that violations are being properly recorded and reported.

6. Allow citizens to act immediately in cases of imminent and substantial health threats. Currently, if there is a threat of imminent danger to public health from contaminated drinking water, citizens have no immediate recourse through the court system. Instead, at most they can petition the EPA to exercise its emergency authority to take action—as they did in Flint. If citizens want to file their own action, they have to wait for months after formally notifying the EPA and the State that there is a violation.

Many sewage treatment plants are unable to fully remove pollutants and can contaminate drinking water sources, especially after major storms when their treatment capacity may be overwhelmed.

Introduction to the Safe Drinking Water Act

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The introduction of filtration and chlorination of drinking water in the United States in the early 20th century significantly improved public health. In major U.S. cities, clean drinking water reduced infant deaths by three-quarters, child deaths by two-thirds, and adult deaths by half.[19] But in the 1960s there were still 130 known disease outbreaks or poisonings, generally linked to dangerous pathogen contamination of water.[20] At the same time, the influx of new industrial and agricultural chemicals into the water supply began to raise concerns. A 1974 government study found that 36 percent of national tap water samples contained unsafe levels of bacteria or chemicals.[21] Other studies showed that drinking water systems were severely ill equipped to treat and deliver safe drinking water. Scientific evaluations showing chemicals in treated drinking water—like asbestos in Duluth, Minnesota, and other carcinogens in New Orleans—prompted Congress to act.

In 1974, Congress overwhelmingly passed, and President Gerald Ford signed into law, the Safe Drinking Water Act (SDWA).[22] This law required the newly established U.S. Environmental Protection Agency (EPA) to develop health standards for drinking water from "public water systems."[f] These systems are defined as water suppliers (private or public) that serve piped drinking water to 15 service connections or at least 25 people.[23] Importantly, it does not protect tap water from very small water suppliers or private wells, nor does it cover bottled water (which is separately regulated by the Food and Drug Administration).

Under the SDWA, the EPA sets health-based standards for contaminants that appear in drinking water. For some contaminants, the EPA requires treatment to reduce hazards from waterborne pathogens, like *Giardia* and *Cryptosporidium* (two parasites that can cause gastrointestinal distress, nausea, and diarrhea). For toxic chemicals like arsenic or industrial chemicals that can cause cancer or other serious diseases, the EPA has established maximum allowable levels in water. Over the decades, modern treatment technologies and SDWA regulations have substantially reduced the number of deaths and serious illnesses caused by contaminated tap water, including cancer, miscarriages, and impaired development.[24]

f In its Public Water System Supervision Program, authorized under the 1974 SDWA, the EPA covers two types of public water supplies: (1) community water systems, which regularly serve the same customers year-round, and (2) noncommunity water systems, which serve different people at different times or serve people for only part of the year (such as factory, school, or campground water systems). In this report, we focus on violations by community water systems, since that is where most people get most of their drinking water most of the time. This limitation also avoids double-counting people who may get water from both community and noncommunity water systems that are in violation.

Safe Drinking Water Act Rules

Primarily, the SDWA requires the EPA to establish regulations to restrict the levels of contaminants in drinking water. A "contaminant" is defined as "any physical, chemical, biological, or radiological substance or matter in water." The EPA must set a maximum contaminant level goal (MCLG) that is fully protective of health for drinking water contaminants. At the same time, the agency must establish maximum contaminant levels (MCLs) as close to the MCLG as is "feasible," considering technological limitations and costs. In other words, the EPA sets a contaminant limit for completely safe drinking water, and then sets a looser standard for tap water that accounts for feasibility and costs—and isn't necessarily safe. For example, the EPA's MCLG for arsenic, a known human carcinogen, is zero because no level of arsenic is safe. Because of costs, however it set the enforceable arsenic MCL at 10 parts per billion (ppb). Even at that level, according to the National Academy of Sciences, substantial cancer risks remain.[25]

Water systems are required to provide public warnings of contamination to their customers only if they violate the MCL or the prescribed treatment technique, so a system with as much as 10 ppb arsenic, for example, would not be required to issue a public notification. But if compliance with MCLs is not fully health-protective, MCL violations are even more worrisome. Water systems are supposed to provide annual water quality reports (sometimes called consumer confidence reports) to their customers summarizing the results of testing for contaminants in their water; larger systems are required to post those reports on the web.[26]

If the EPA finds it is not technologically or economically feasible to ascertain the level of a contaminant in drinking water, it is required to establish a treatment technique instead of an MCL. For example, the EPA has found that it is not feasible to ascertain the level of *Cryptosporidium* (which causes intestinal disease) in drinking water, so it has established a treatment technique that requires filtration and disinfection (see Appendix 3: Surface Water Treatment Rules and Groundwater Rule). Public water systems are responsible for satisfying an MCL or treatment technique, under the supervision of state drinking water officials and with ultimate oversight by the EPA.

Overall, the EPA has established primary drinking water regulations for about 100 of the many thousands of known or anticipated contaminants that appear in tap water.[27] They are classified under individual rules that establish specific MCLGs and MCLs or treatment techniques (see Table 1 and appendices). These rules cover a wide array of health impacts that range from gastrointestinal illness to cancer to birth defects to nervous system problems.

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Health and environmental experts have criticized the EPA for the low number of regulated contaminants and for its failure to adopt a single new standard since the provisions for setting new drinking water standards passed in 1996.[28] There are two main reasons for the slow progress. First, the law is complex and the EPA has limited resources to complete all the steps legally required to adopt a new standard. The EPA must, for example, convene an advisory council, make scientific determinations about the toxicity of the contaminant, and create and evaluate a national database on the extent of its occurrence. It must make findings on its likely occurrence in drinking water, evaluate peer-reviewed studies, and publish a proposed list of contaminants for consideration. Further, it must complete a "health risk reduction and cost analysis"[29] and determine that "regulation of such contaminant presents a meaningful opportunity for health risk reduction."[30] Only then can the EPA propose a standard, take public comment, and then finalize it. Each of these requirements (and there are more) strains an agency already constrained with staff restrictions and a diminishing budget.

Second, the EPA has lacked the will to adopt standards in the face of political opposition from the water industry and other industries, local governments, antiregulatory members of Congress, and even other federal agencies reluctant to assume greater liability. Because drinking water standards generally become minimum cleanup standards for Superfund and other hazardous waste sites, a tough MCL can cost polluting industries (or government agencies like the Department of Defense) a lot of money for cleanup. This creates incentives for them to fight the EPA's adoption of strong MCLs.

TABLE 1: RULE DESCRIPTIONS		
RULE NAME	**DESCRIPTION**	**RANGE OF MAJOR HEALTH IMPACTS**
Combined Disinfectants and Disinfection Byproducts Rules	Establish health standards for disinfection byproducts that apply to community water systems that add disinfectants to their water. While adding chlorine or other chemical disinfectants to water has benefits, these disinfectants can react with organic matter in the water to create byproducts that can adversely impact human health.	Exposure can lead to cancer and potentially to reproductive impacts such as miscarriages and birth defects.
Total Coliform Rule	Sets an MCLG and MCL for the presence of total coliforms in drinking water. "Coliforms" refers to a family of bacteria common in soils, plants, and the guts of animals. (Note: This rule was revised in 2013 but didn't go into effect until 2016. This report focuses on 2015, and therefore on the earlier rule before it was revised.)	Coliforms indicate that disinfection may not be working and that disease-causing organisms may be present. These organisms can cause diarrhea, cramps, nausea, and headaches and pose potentially more serious health threats for children, the elderly, and immune-compromised people.
Combined Surface, Ground Water, and Filter Backwash Rules[g]	Establish treatment requirements to protect people from potential pathogens from ground water or surface water sources.	Some of the pathogens covered, such as *Cryptosporidium* and Giardia, can cause severe gastrointestinal distress, nausea, and diarrhea. In the very young, the elderly, and immune-compromised people, they can cause serious, life-threatening infections.
Nitrate and Nitrite Rule[h]	Sets an MCLG and MCL for nitrates and nitrites in drinking water. These contaminants commonly come from runoff carrying synthetic fertilizer or waste from large animal agriculture operations, or from human sewage or septic systems.	Exposure can lead to blue baby syndrome in infants, developmental defects, and in extreme cases infant death. Long-term exposure above the MCL can lead to impaired thyroid function and damaged cardiovascular health. These chemicals may also cause cancer.[31]
Lead and Copper Rule	Mandates a complex treatment technique to control lead levels in tap water. All water systems serving more than 50,000 people must either treat their water to "optimize corrosion control" or demonstrate that their water isn't corrosive and no lead problems exist. Additional requirements also apply.	Lead exposure is particularly toxic to children and can cause serious, irreversible damage to developing brains and other parts of the nervous system. Exposure can also cause miscarriages and stillbirths, fertility issues, cardiovascular and kidney impacts, cognitive dysfunction, and elevated blood pressure in healthy adults.
Radionuclides Rule	Regulates combined radium-226/228; (adjusted) gross alpha, beta particle and photon radioactivity; and uranium.	Exposure can lead to cancers and in some cases impaired kidney function.
Arsenic Rule	Sets an MCLG and MCL for arsenic in drinking water.	Exposure to arsenic, a known human carcinogen, can lead to cancers, developmental defects, pulmonary disease, and skin or cardiovascular disease.
Synthetic Organic Contaminants Rule	Sets an MCLG and MCL for 34 synthetic organic (man-made) chemicals that do not exist in nature.	Exposure can lead to cancers, developmental defects, central nervous system and reproductive difficulties, endocrine issues, and liver and kidney problems.
Inorganic Contaminants Rule	Sets an MCLG and MCL for 12 inorganic contaminants (excluding nitrate and nitrite), materials of mineral origin that may be present in water due to human activity, such as mining.	Exposure risks vary by chemical but can include increased cholesterol, kidney damage, hair loss, skin irritation, and cancer.
Volatile Organic Contaminants Rule	Sets an MCLG and MCL for 21 volatile organic contaminates (VOCs), which are gases at room temperature.	Exposure can lead to cancers; developmental, skin, and reproductive issues; and cardiovascular problems. Exposure can also have adverse effects on the liver, kidneys, and immune and nervous systems.

g Includes the Ground Water, Surface Water, Filter Backwash, Long Term 1 Enhanced Surface Water Treatment, and Long Term 2 Enhanced Surface Water Treatment Rules.
h Regulated under Phase II of the Inorganic Contaminants Rule. EPA classifies these contaminants independently in the Safe Drinking Water Information System.

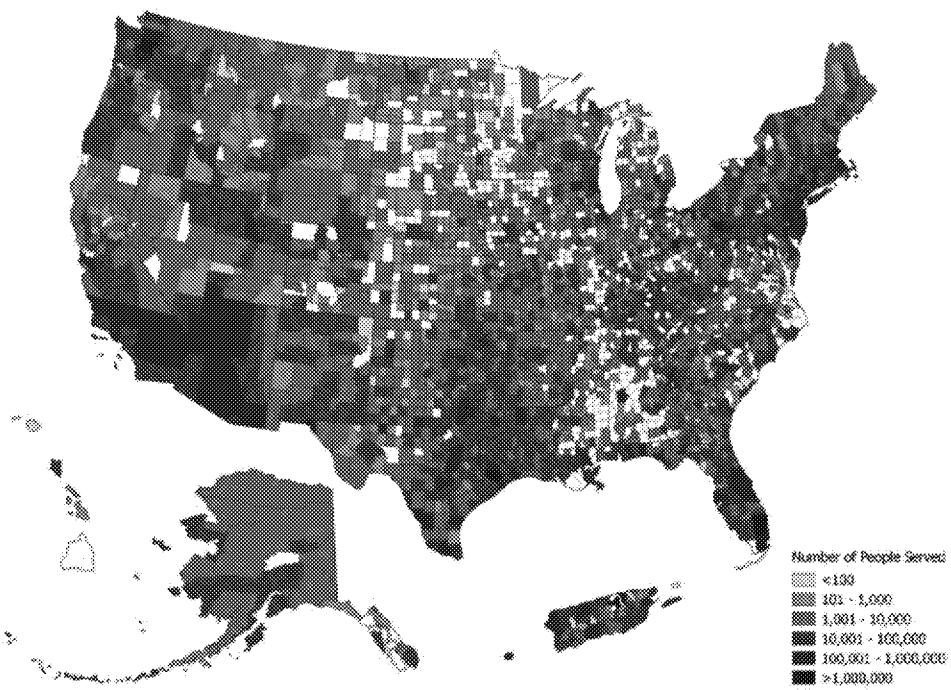
Violating the Drinking Water Rules

SDWA violations generally fall into two categories: health-based violations, and monitoring and reporting violations. Health-based violations occur when the drinking water contains chemicals in excess of the MCL or when the system fails to properly treat water to prevent contamination.[i] Monitoring and reporting violations include a water system's failure to take samples and test the quality of its drinking water according to the schedule established by the EPA, or its failure to report results to the state, the EPA, or its customers (when required) in a timely manner. While monitoring and reporting violations are not technically health based, these violations can mask serious underlying issues such as contamination. Without proper monitoring and reporting, it is impossible to determine whether health-based standards have been met.

ALL VIOLATIONS

In 2015, there were 80,834 reported SDWA violations (including health-based violations and monitoring and reporting violations) at 18,094 community water systems across the country.[j,k] That means that roughly one out of three of the approximately 52,000 community water systems in the United States had a reported violation. These water systems served 76,922,570 people, or nearly one-fourth of the U.S. population (see Table 2).[l] As discussed in greater detail below, the actual number of violations and systems breaking the law is likely substantially higher because of probable widespread underreporting.

FIGURE 1: 76.9 MILLION PEOPLE SERVED BY COMMUNITY WATER SYSTEMS WITH AT LEAST ONE REPORTED VIOLATION OF THE SAFE DRINKING WATER ACT (2015). POPULATIONS ARE SHADED AT THE COUNTY LEVEL TO SHOW THE NUMBER OF RESIDENTS SERVED BY COMMUNITY WATER SYSTEMS WITH VIOLATION(S) IN 2015.



i These latter violations include Maximum Residual Disinfectant Level (MRDL) violations, which occur when a disinfectant exceeds the highest level allowed in drinking water. Disinfection is important for limiting microbial contamination but can have harmful impacts if levels are too high.

j We used EPA data for all violations during calendar year 2015, using the most up-to-date data available (released in October 2016, the "2016 quarter 3 data set"), from the Safe Drinking Water Information System.

k As noted earlier, in this report we track only violations by community water systems. We do not summarize the violations by the approximately 100,000 noncommunity water systems (such as school, factory, or commercial facility drinking water systems that don't supply the same customers full time year-round) because this could result in double counting of people served by both types of systems in violation.

l Total U.S. population (estimated) on January 1, 2015, was 321,418,820. Data from the Annual Estimates of the Resident Population for the United States, Regions, States, and Puerto Rico: April 1, 2010, to July 1, 2015 (NST-EST2015-01), U.S. Census Bureau, Population Division.

TABLE 2: VIOLATIONS OF THE SAFE DRINKING WATER ACT IN CALENDAR YEAR 2015 RANKED BY POPULATION SERVED[m]			
RULE NAME	POPULATION SERVED	NUMBER OF VIOLATIONS	NUMBER OF SYSTEMS
All Violations	76,922,570	80,834	18,094
Combined Disinfectants and Disinfection Byproducts Rules[n]	25,173,431	11,311	4,433
Lead and Copper Rule	18,350,633	8,044	5,367
Total Coliform Rule	17,768,807	10,261	5,233
Combined Surface, Ground Water, and Filter Backwash Rules[o]	17,312,604	5,979	2,697
Right-to-Know ("Consumer Confidence") Rule	14,422,712	7,906	5,030
Public Notification Rule	8,381,050	13,202	3,394
Nitrates and Nitrites Rule	3,867,431	1,529	971
Volatile Organic Contaminants Rule	3,451,072	10,383	406
Synthetic Organic Contaminants Rule	2,669,594	6,864	311
Arsenic Rule	1,842,594	1,537	573
Radionuclides Rule	1,471,364	2,297	523
Inorganic Contaminants Rule	1,312,643	1,505	224
Miscellaneous Rules	3,718	16	10

By population served, the top five SDWA rules violated by community water systems in 2015 were those addressing:

1. disinfectants and disinfection byproducts
2. lead and copper
3. total coliform
4. surface water and ground water quality (i.e., pathogens)
5. the "consumer confidence" rule, which seeks to ensure the public's right to know about possible violations by requiring annual water quality reports to be provided to consumers.

Table 1 describes each drinking water rule, common sources of the regulated contaminants, and the health risks. The appendices provide more information about each rule and a detailed breakdown of the violations.

In 2015, violations were reported in all 50 states, the District of Columbia, Puerto Rico, and other territories covered by the SDWA (including Guam, American Samoa, the U.S. Virgin Islands, and the Northern Mariana Islands). When ranked by population served by systems with SDWA violations, the top five states were:

1. Texas (12,066,920 people served[p])
2. Florida (7,540,465 people served)
3. Pennsylvania (5,645,903 people served)
4. New Jersey (4,487,703 people served)
5. Georgia (3,846,734 people served)

When ranking by percentage of total population served, Puerto Rico had the highest percentage of any state or territory, with a whopping 99.5 percent of its population served by community water systems in violation of the SDWA.[q]

While monitoring and reporting violations are not technically health based, these violations can mask serious underlying issues such as contamination. Without proper monitoring and reporting, it is impossible to determine whether health-based standards have been met.

m Data from the 2016 quarter 3 data set of the Safe Drinking Water Information System, https://ofmpub.epa.gov/apex/sfdw/f?p=108:200.
n Includes the Stage 1 and Stage 2 Disinfectants and Disinfection Byproducts Rules.
o Includes the Surface Water, Ground Water, Filter Backwash, Long-Term 1 Enhanced Surface Water Treatment, and Long-Term 2 Enhanced Surface Water Treatment Rules.
p "People" refers to individuals served by community water systems in the given time frame and location. It does not equate with households.
q In 2015, the estimated population of Puerto Rico was 3,474,182 people (from the Annual Estimates of the Resident Population for the United States, Regions, States, and Puerto Rico: April 1, 2010, to July 1, 2015 (NST-EST2015-01), U.S. Census Bureau, Population Division.

The data also show that very small systems, such as those in rural and more sparsely populated areas, had a higher percentage of violations of the health standards and a substantially higher percentage of total violations compared with larger systems. Systems serving less than 500 people accounted for nearly 70 percent of all violations and a little over half of all health-based violations.[r] This is not especially surprising, for as EPA has noted in discussing the serious problem of noncompliance in many small systems:

> In general, large [systems] have greater capacity to maintain compliance than small systems and can return to compliance more quickly than small systems. This disparity is often the result of differences in financial, administrative and technical capacity between large and small systems. Small [systems] have a smaller customer base to support purchase and installation of needed infrastructure and to operate and maintain the system. Similarly, small PWSs [public water systems] may be unable or unwilling to charge consumers rates sufficient to cover the true cost of collecting, treating and distributing the water. Lack of funding may cause small PWSs to delay needed capital improvements. Small PWSs . . . are often overseen by part-time administrators who are not environmental professionals, and the pay for the system operators may not be adequate to attract and keep someone with the necessary training and skills. If there are violations, small PWSs may not have the technical capabilities to correct the underlying problems.[32]

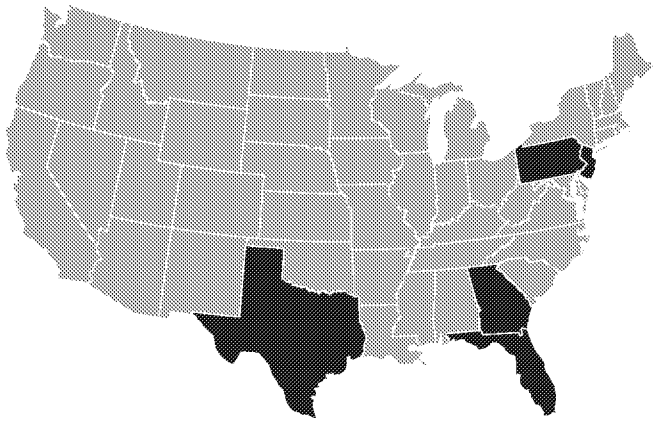
Because monitoring and reporting violations could hide more serious health-based violations, we should invest in these very small systems or restructure or consolidate them with other water systems to help them build the capacity to properly monitor and report on drinking water quality.

HEALTH-BASED VIOLATIONS

In 2015, 12,137 health-based SDWA violations were reported at 5,009 community water systems across the country. These systems served 27,412,987 people, or nearly 1 out of every 12 Americans (see Table 3).[s] By populations served, the top five SDWA rules with health-based violations by community water systems in 2015 addressed:

1. disinfection byproducts
2. coliform bacteria
3. surface water and groundwater quality (i.e. pathogens)
4. nitrates and nitrites
5. lead and copper

IN 2015, THERE WERE 80,834 REPORTED SDWA VIOLATIONS AT 18,094 COMMUNITY WATER SYSTEMS ACROSS THE COUNTRY



TOP FIVE STATES WITH SDWA VIOLATIONS BY POPULATION:

1. TEXAS: **12,066,920** PEOPLE SERVED
2. FLORIDA: **7,540,465** PEOPLE SERVED
3. PENNSYLVANIA: **5,645,903** PEOPLE SERVED
4. NEW JERSEY: **4,487,703** PEOPLE SERVED
5. GEORGIA: **3,846,734** PEOPLE SERVED

PUERTO RICO

99.5% IN VIOLATION

When ranking by percentage of total population served, Puerto Rico had the highest percentage of any state or territory, with a whopping 99.5 percent of its population served by community water systems in violation of the SDWA.

r According to NRDC analysis of SDWIS data, very small water systems (those serving less than 500 people) had 54,428 violations out of the total 80,834 total violations (67.3 percent) in 2015. For health-based violations, very small systems had 6,238 violations out of the total 12,137 health-based violations (51.4 percent).

s Total U.S. population (estimated) on January 1, 2015, was 321,418,820. Data from the Annual Estimates of the Resident Population for the United States, Regions, States, and Puerto Rico: April 1, 2010, to July 1, 2015 (NST-EST2015-01, U.S. Census Bureau, Population Division.

FIGURE 2: 27.4 MILLION PEOPLE SERVED BY COMMUNITY WATER SYSTEMS WITH AT LEAST ONE REPORTED HEALTH-BASED VIOLATION OF THE SAFE DRINKING WATER ACT (2015). POPULATIONS ARE SHADED AT THE COUNTY LEVEL TO SHOW THE NUMBER OF RESIDENTS SERVED BY COMMUNITY WATER SYSTEMS WITH VIOLATION(S) IN 2015.

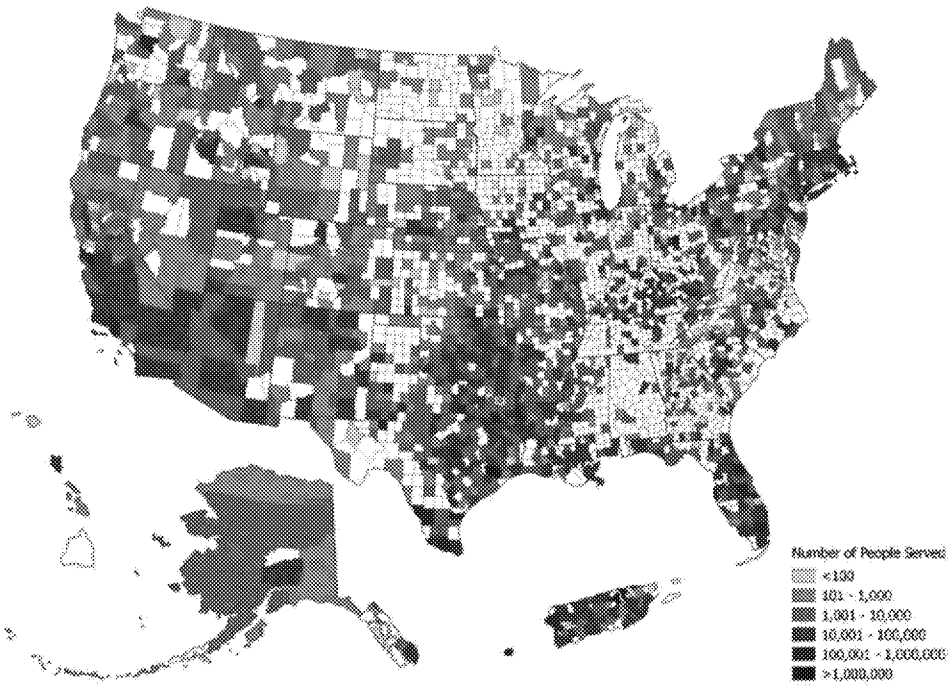


TABLE 3: HEALTH-BASED VIOLATIONS OF THE SAFE DRINKING WATER ACT IN CALENDAR YEAR 2015 RANKED BY POPULATION SERVED[t]

RULE NAME	POPULATION SERVED	NUMBER OF VIOLATIONS	NUMBER OF SYSTEMS
All Violations	27,412,987	12,137	5,009
Combined Disinfectants and Disinfection Byproducts Rules[u]	12,584,936	4,591	1,552
Total Coliform Rule	10,118,586	2,574	1,909
Combined Surface, Ground Water, and Filter Backwash Rules[v]	5,336,435	1,790	813
Nitrates and Nitrites Rule	1,364,494	459	192
Lead and Copper Rule	582,302	303	233
Radionuclides Rule	445,969	962	258
Arsenic Rule	358,323	1,135	352
Synthetic Organic Contaminants Rule	301,099	17	13
Inorganic Contaminants Rule	83,033	291	77
Volatile Organic Contaminants Rule	5,276	15	6

t Data from the 2016 quarter 2 data set of the Safe Drinking Water Information System.
u Includes the Stage 1 and Stage 2 Disinfectants and Disinfection Byproducts Rules.
v Includes the Surface Water, Ground Water, Filter Backwash, Long-Term 1 Enhanced Surface Water Treatment, and Long-Term 2 Enhanced Surface Water Treatment Rules.

Health-based SDWA violations were seen in all 50 states as well as Puerto Rico and other territories (excluding Guam and the District of Columbia). When ranked by population served by systems with health-based violations, the top five states or territories were:

1. Texas (4,970,249 people served)
2. Puerto Rico (2,410,809 people served)
3. Ohio (2,315,260 people served)
4. Maryland (1,754,409 people served)
5. Kentucky (1,513,617 people served)

When ranked by percentage of total population served, Puerto Rico again had the highest percentage of any state or territory, with 69.4 percent of its population served by community water systems with health-based SDWA violations.[w]

UNDERESTIMATING THE PROBLEM

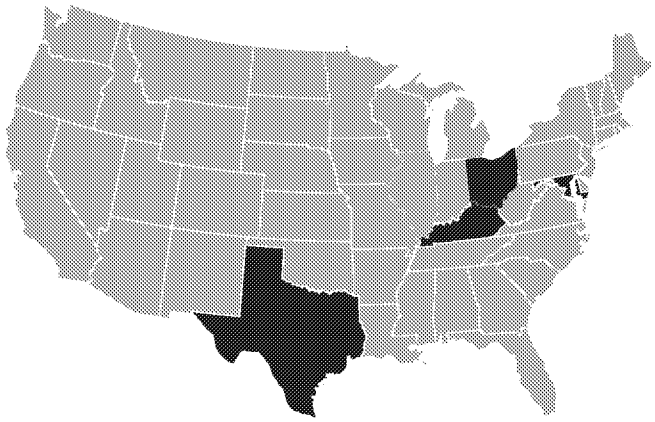
There are at least five major reasons the data included in this report understate the extent of drinking water contamination in the United States.

First, the EPA regulates around 100 of the many thousands of contaminants found in tap water. As noted earlier, the EPA has not established a standard for a single new contaminant since the 1996 amendments to the SDWA were enacted, even though it has a list of scores of currently unregulated contaminants.

For example, polyfluoroalkyl and perfluoroalkyl substances (PFASs) have been associated with myriad negative health impacts, including cancer, endocrine disruption, neonatal death, and adverse neurobehavioral effects. These toxic chemicals are released from industrial, firefighting, and military operations.[33] They were recently identified by Harvard researchers in the tap water of more than six million Americans.[34] But they are not included in this analysis because they are not currently regulated under the SDWA, even though the EPA has expressed concern about them. In lieu of a rule to regulate these toxic chemicals, the EPA has issued a "health advisory," a nonbinding warning that establishes an unenforceable safe level. These advisories merely inform federal, state, and water system officials about how much of the chemicals are safe in water and are not federal regulatory standards.[35]

Similarly, algal toxins are not regulated. Instead, the EPA has established a nonenforceable health advisory establishing the levels at which adverse health impacts are anticipated from drinking water containing these cyanotoxins. These specific toxins are created in polluted water bodies by particular algae that are becoming more widespread. For example, in 2014, Toledo, Ohio, issued a "do not drink" order for 400,000 people during a toxic algal bloom.[36] As waters continue to warm due to climate change, and as nitrates and phosphorus continue to inundate drinking water sources, these harmful algal blooms will continue to increase.[37]

IN 2015, 12,137 HEALTH-BASED SDWA VIOLATIONS WERE REPORTED AT 5,009 COMMUNITY WATER SYSTEMS ACROSS THE COUNTRY. THESE SYSTEMS SERVED 27,412,987 PEOPLE, OR NEARLY 1 OUT OF EVERY 12 AMERICANS.



TOP FIVE SYSTEMS WITH HEALTH-BASED VIOLATIONS:

1. TEXAS: **4,970,249** PEOPLE SERVED
2. PUERTO RICO: **2,410,809** PEOPLE SERVED
3. OHIO: **2,315,260** PEOPLE SERVED
4. MARYLAND: **1,754,409** PEOPLE SERVED
5. KENTUCKY: **1,513,617** PEOPLE SERVED

PUERTO RICO

69.4% IN VIOLATION

When ranked by percentage of total population served, Puerto Rico again had the highest percentage of any state or territory, with 69.4 percent of its population served by community water systems with health-based SDWA violations.

w In 2015, the estimated population of Puerto Rico was 3,474,182 people (from the Annual Estimates of the Resident Population for the United States, Regions, States, and Puerto Rico: April 1, 2010, to July 1, 2015 (NST-EST2015-01); U.S. Census Bureau, Population Division.

Second, even when contaminants are regulated, the EPA's monitoring rules often allow water utilities to intentionally or unintentionally avoid detecting exceedances and recording a violation. In the report "What's in Your Water: Flint and Beyond," for example, we detailed water systems' many methods of avoiding detection of excessive lead levels in their water and thus avoiding a violation or exceedance of the lead action level.[38,x] Similarly, the monitoring rules for most pesticides and other chemicals require only quarterly (and sometimes even less-frequent) monitoring. The contamination levels of the pesticide atrazine or other seasonally applied chemicals, for example, can peak in streams shortly after they are applied to crops.[39] According to the U.S. Geological Survey, overall variation in pesticide levels in a stream "sometimes exceed[s] four orders of magnitude," depending on when the sample is taken, and varies seasonally and according to hydrologic conditions.[40] A water system, therefore, would not be likely to detect an exceedance if the water was tested shortly before seasonal pesticide application. In ways like this, the EPA's monitoring rules can allow problematic water contamination to go undetected and unreported without violations of the letter of the law.

Third, numerous EPA data audits confirm that states often fail to report all violations to the agency's database, as is legally required.[y] For example, the EPA's inspector general reported in 2004 that the EPA's internal audits found states reporting just 65 percent of all health-based violations and only 23 percent of the monitoring and reporting violations.[41] The inspector general's own audit also found that while data quality may have improved, it was still problematic and underreporting was widespread. (More recent comprehensive data audits, if they exist, have not been made public.) Thus, it is clear that many violations are not captured in the data and maps included in this report. Indeed, the EPA's latest annual compliance report (issued in 2015 and reflective of 2013) confirmed that state violations data reported to the EPA (and the basis of the figures in this study) are "substantially incomplete."[42] Even a cursory review of the data that have been submitted shows that many states suspiciously had zero violations of entire classes of standards.[43] For example, many states had no reported violations of the various rules related to microbial contamination in surface water and groundwater, even though they have about as many water systems as neighboring states that reported significant numbers of such violations.

The inspector general's own audit also found that while data quality may have improved, it was still problematic and underreporting was widespread.

The fourth reason we can assume that the extent of drinking water contamination is understated is that the EPA and its inspector general have raised the specter of water systems falsifying data to hide violations.[44] The EPA's entire drinking water program relies heavily on information submitted by the water systems themselves. States are not required to have programs to detect falsified data, and very few states have such programs. More than a decade ago, the inspector general conducted an audit, which has not been publicly updated, that found that of all the data public water systems reported to the audited states, 18 percent was questionable and 12 percent was invalid or potentially falsified.[45]

Finally, most of the EPA's rules require that monitoring for most chemicals be conducted at the water treatment plant or at the "point of entry" into the distribution system (such as at a wellhead). This is fine for contaminants that come from the source water. However, it doesn't catch contaminants that enter the water through the pipes. While EPA rules require at-the-tap testing for certain contaminants (lead, copper, coliform, disinfectants, and disinfection byproducts), it is not required for others that can come from pipes such as asbestos and vinyl chloride, which are known carcinogens. It is estimated that across America, hundreds of thousands of miles of asbestos cement pipe have been used for carrying water, much of it for water mains (though also for sewage pipes and storm drains).[46] Much of this pipe may now be deteriorating and releasing asbestos into tap water.[47] Similarly, polyvinyl chloride (PVC) plastic has often been used in water pipes. Vinyl chloride, the cancer-causing component of PVC, can leach from these pipes, especially those made before 1977.[48]

x EPA did issue a memorandum on February 29, 2015, asking water systems not to use three of the most widely known testing methods that can avoid detecting elevated lead levels in tap water. The Lead and Copper Rule requires a system to control the corrosivity of water and to monitor tap water. If lead concentrations in more than 10 percent of the taps exceed the "action level" (which is not health-based), then the water system has to take additional steps to control the corrosion.

y In the EPA's euphemistic words, the state reporting of violations is said to be "incomplete." As the agency's most recent annual compliance report admits, EPA has evaluated state and EPA regional program data quality by conducting data verification audits and national data quality assessments, comparing primacy agencies' files and records with information in SDWIS/FED to verify accuracy, completeness and whether appropriate compliance determinations are made (that is, in accordance with federal regulations). These audits and assessments have shown that violation data are incomplete. EPA, "Providing Safe Drinking Water in America: 2013 National Public Water Systems Compliance Report," 2015. https://www.epa.gov/sites/production/files/2015-06/documents/sdwacom2013.pdf.

Enforcement Provisions of the Safe Drinking Water Act

Under the SDWA, states, territories, and federally recognized Native American tribes can apply for "primary enforcement responsibility," or primacy. This designation essentially means that the EPA has determined that the state, territory, or tribe's rules are at least as strict as the federal standards and that the entity in question can and will enforce the law. Once a state is granted primacy, it receives substantial federal funding to carry out the law. All 50 states have primacy under the Safe Drinking Water Act, except Wyoming (which has chosen not to apply for it). The Navajo Nation is the only Indian tribe to have sought and received primacy; Puerto Rico and some other U.S. territories also have been approved for primacy. The District of Columbia does not have primacy.

Once the EPA establishes health standards and monitoring and reporting rules, primacy states are supposed to enforce them and to report any violations and related information to the EPA every quarter. When a violation occurs, the state is required to bring the system back into compliance. This tends to begin with informal enforcement steps, such as warning letters, phone calls, or field visits. If the violation continues or recurs, the state is supposed to initiate a formal enforcement process to bring the system into compliance. Actions could include issuing an administrative order, seeking administrative fines, referring a civil case to the state attorney general, or even requesting the filing of criminal charges. Public water systems must also notify their customers of violations or potential risks to their health (see more on the Public Notification Rule in Appendix 12). If the EPA finds that a public water system in a primacy state violates a rule, the agency must notify both the system and the state and assist in bringing the system back into compliance. If the state fails to take enforcement action within 30 days of notice, the EPA is legally obligated to issue an administrative order or file an enforcement case against the violator.[49]

The EPA retains enforcement authority and responsibility in primacy states if state officials fail to ensure that the law is adequately enforced, or if there is an "imminent and substantial endangerment to the health of persons."[50]

It is important to note that while the EPA has this authority to act in the case of an "imminent and substantial" harm to health, it often does not act. For example, as the Flint disaster festered for months, NRDC and the American Civil Liberties Union of Michigan (ACLU-MI), representing local citizens and organizations, formally petitioned the EPA to act in light of the imminent and substantial danger posed by the lead contamination. Despite the mounting evidence, the EPA took 112 days after the citizen petition was filed (and nearly a year

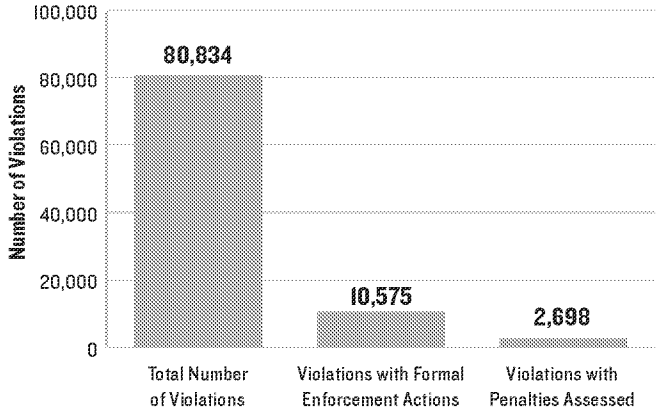
after it learned of Flint's lead problems) before issuing an emergency order.[51] It did so only after Flint sparked a national media firestorm and became a major public controversy. In fact, the Office of the Inspector General (OIG)—an independent office within the EPA tasked with investigating the agency to prevent fraud, waste, and abuse—recently criticized the agency's response to Flint. It also emphasized the EPA's authority to immediately issue an administrative order or to bring a case in court if a contaminant "may present an imminent and substantial endangerment to the health of persons," even if no violation of the law is proven.[52]

But both state agencies and the EPA have failed to enforce the SDWA. Sometimes the agencies argue that they would rather work with water utilities as partners as opposed to adversaries. Other times they cite insufficient resources for additional enforcement. While the EPA is under-resourced and could use additional staff and funding, it certainly has the capacity and authority to take substantially more enforcement actions.

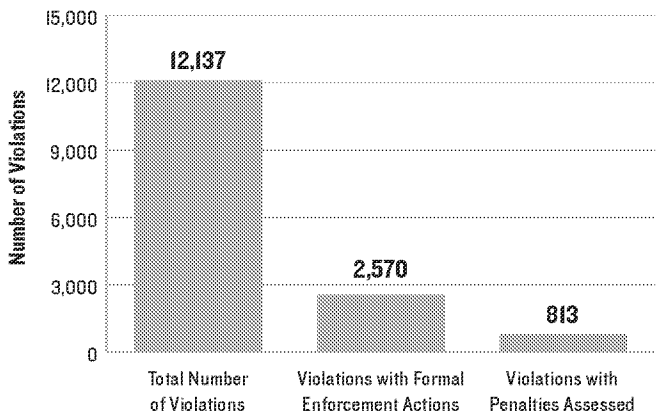
NRDC's analysis of EPA Safe Drinking Water Information System (SDWIS) data reveals that the EPA or states took formal enforcement action in only 13.1 percent of the 80,834 reported SDWA violations in 2015.[z] A little less than one out of every four violations (23.0 percent, or 18,567 violations) returned to compliance by the end of the year. In other words, almost nine out of ten violations faced no formal federal or state enforcement, and more than three-fourths of violations were not returned to compliance by the end of the year. Only 3.3 percent of all violations (2,698) faced any penalties from states or the federal government.

The EPA and states took formal enforcement action in 21.2 percent of the 12,137 health-based violations reported in 2015.[aa] A little more than one out of every three cases (20.5 percent or 2,488 violations) returned to compliance by the end of the year. An even smaller number of violations (813, or 6.7 percent) of heath-based violations faced any penalties.

FORMAL ENFORCEMENT ACTIONS FOR VIOLATIONS OF THE SAFE DRINKING WATER ACT



FORMAL ENFORCMENT ACTIONS FOR HEALTH-BASED VIOLATIONS OF THE SAFE DRINKING WATER ACT



z Formal enforcement action was taken for 10,575 violations to the Safe Drinking Water Act in 2015). The federal government was responsible for 4.9 percent of formal enforcement actions (520 violations), and states were responsible for 95.1 percent (10,055 violations). Any enforcement action (including formal and informal actions) was taken in 86.0 percent of cases (69,546 violations).

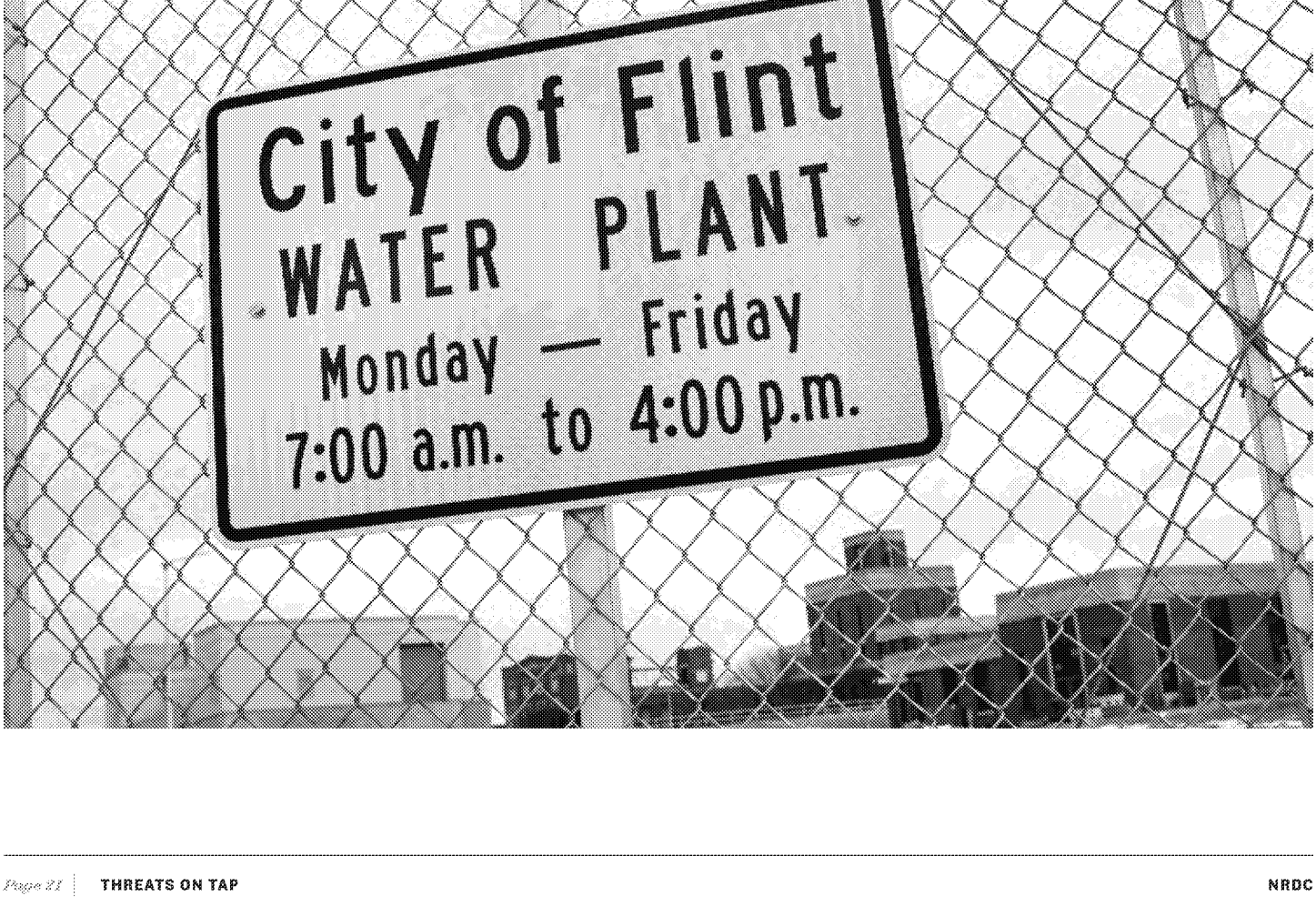
aa Formal enforcement action was taken for 2,570 health-based violations of the Safe Drinking Water Act in 2015. The federal government was responsible for 11.9 percent of formal enforcement actions (307 violations), and states were responsible for 88.1 percent (2,261 violations). Any enforcement action (including formal and informal actions) was taken in 95.4 percent (11,577 violations) of cases.

Citizen Suit Provision of the Safe Drinking Water Act

Citizens have some recourse, but it is limited. The SDWA allows citizens to bring lawsuits against the EPA, the state, or the public water system for a violation or against the EPA for failure to perform a mandatory duty.[53] However, the law imposes a 60-day waiting period before such a suit can be brought. Unfortunately, this can mean substantial delays during an ongoing health threat. For example, in Flint, in the face of the state's and the EPA's failure to take enforcement action, NRDC and the ACLU-MI had to wait two months after notifying the EPA, the state of Michigan, and the water system before filing a case.[54] In the meantime, thousands of residents continued to receive toxic water that posed both long- and short-term risks.[55]

Another problem is that the citizen suit provision does not impose penalties on violators. Other statutes, like the Clean Air Act and the Clean Water Act, have citizen suit provisions that include such penalties. These penalties incentivize compliance because they accrue from the first day of the violation. The sooner a violation is resolved, the lower the penalty. Without these penalties, public drinking water systems can drag out cases for years, further prolonging public health threats.

Some laws designed to protect public health allow citizens to bring lawsuits when a contaminant "may present an imminent and substantial endangerment to the health of persons" even if they cannot prove a legal violation (e.g., the Resource Conservation and Recovery Act (RCRA), which covers solid and hazardous waste disposal).[56] The SDWA stipulates that if the EPA finds an imminent and substantial danger, the agency may (but is not required to) take legal action, but citizens lack that power. The weaknesses of the SDWA citizen suit section and in the act's imminent and substantial endangerment provision leave the EPA responsible for taking proactive and prompt action to protect vulnerable people from contaminated drinking water if states fail to do so.



FIX, UPGRADE, AND MAINTAIN OUR DRINKING WATER DISTRIBUTION SYSTEMS AND MODERNIZE DRINKING WATER TREATMENT

The majority of the violations detailed in this report can be attributed, at least in part, to America's aging or inadequate drinking water infrastructure. Leaking pipes and lead service lines as well as unprotected sources, water tanks, and reservoirs are just some of the problems that can introduce bacterial and chemical contamination and violate drinking water rules. Outdated or inadequate water treatment plants can allow contaminants like pathogens, arsenic, pesticides, and industrial chemicals to slip past treatment and travel straight to customers. In some cases, inadequate treatment can actually cause contamination; for example, outdated disinfection equipment can contaminate water with cancer-causing disinfection byproducts. These problems afflict water systems large and small, but as noted, violations of health and treatment standards are more common in small systems than they are in larger ones.

In 2017, the American Society of Civil Engineers (ASCE) gave U.S. drinking water infrastructure a D grade.[57] Clearly we need to replace or repair decaying or outdated parts of the distribution system, such as leaking and crumbling water mains. These old pipes are prone to breaks and significant leakage, wasting water and money and allowing pathogens to penetrate the system or multiply in areas of decay. In many cities, the drinking water infrastructure is 80 to 100 years old—at or near the end of its life cycle. The U.S. Geologic Survey estimates that leaking pipes lose 6 billion gallons of clean drinking water every day.[58] The ASCE estimates that there are 240,000 main breaks every year.[59] There are 6 million to 10 million lead service lines around the United States, contributing to lead-contaminated drinking water.[60] These must be completely replaced.

There are 6 million to 10 million lead service lines around the United States, contributing to lead-contaminated drinking water.

Upgrading and properly maintaining our treatment systems can also help dramatically reduce the number of violations. The EPA estimates that we need $384.2 billion to upgrade drinking water infrastructure; other estimates are far higher.[61] The American Water Works Association, for example, pegs needed investments at more than $1 trillion over the next 25 years.[62] NRDC studies have found that most U.S. drinking water plants still use 100-year-old treatment technologies, such as sand filtration and chlorination. These technologies work fairly well to remove some basic contaminants, such as mud and some bacteria. They cannot, however, effectively remove many of today's widespread regulated and unregulated contaminants such as pesticides, industrial chemicals, pharmaceuticals, and other chemicals.[63] We need to invest in modernizing our treatment plants, as has been done in places like Cincinnati (see sidebar).[64]

The Greater Cincinnati Water Works provides water to more than 700,000 people. In 1992 it became the first major U.S. utility to install granular activated carbon to remove chemical contaminants from the water. In 2013 it completed a $30 million project to install ultraviolet (UV) reactors to kill microorganisms, since UV was found to be one of the most cost-effective means of treating drinking water. UV can kill microorganisms that chlorine disinfection cannot kill, like *Cryptosporidium*. Furthermore, there was concern that the Ohio River watershed was vulnerable to contamination from microorganisms, including those that are naturally resistant to chlorine. The facility can disinfect up to 240 million gallons of drinking water each day.[65]

INVEST IN REPAIRING OUR NATIONAL WATER INFRASTRUCTURE, PRIORITIZING DISPROPORTIONATELY AFFECTED COMMUNITIES AND SUPPLYING MUCH-NEEDED JOBS

Investing in our water infrastructure not only protects public health but strengthens our economy. Industry, commercial development, and robust residential growth all need a safe and dependable source of water.[66] Moreover, major investment in water infrastructure will create hundreds of thousands or even millions of well-paid jobs. The U.S. Senate's bipartisan Water Resources Development Act of 2016 noted that 16.5 jobs are created for every $1 million spent from the state revolving fund.[67] And 506,000 jobs would be created through a $34.7 billion federal capitalization grant to that revolving fund. A recent study found that $188.4 billion in wastewater-related infrastructure alone (including pipe repair and new pipes) spread evenly over the next five years would generate $265.6 billion in economic activity and create close to 1.9 million jobs.[68] The study also found that such infrastructure investments "create over 16 percent more jobs dollar-for-dollar than a payroll tax holiday, nearly 40 percent more jobs than an across-the-board tax cut, and more than five times as many jobs as temporary business tax cuts."[69] The report also estimated job creation by state. In Ohio, for example, this investment could create between 72,000 and 127,000 jobs. In Texas it could create between 74,000 and 147,000 jobs, and in Florida between 90,000 and 102,000.

Major investment in water infrastructure will create hundreds of thousands or even millions of well-paid jobs.

Drinking water infrastructure investments are expected to create jobs at similar levels. The current congressional funding of $2.37 billion per year for water infrastructure must be substantially increased—at least to the approximately $8 billion per year stipulated by the American Recovery and Reinvestment Act of 2009.[70]

Polluting facilities—bringing contaminated drinking water and various adverse health impacts—are routinely sited near communities where people of color and low-income people live, work, and play. Therefore, the EPA and state agencies should better leverage and prioritize funding (including grants) for water infrastructure improvements in these communities.

For smaller water systems struggling to provide safe and reliable drinking water, states should prioritize long-term solutions, such as consolidation or regionalization. Physical consolidation of water systems is particularly feasible when small systems are located near larger ones that can absorb them. Regionalization, where management, technical expertise, purchasing power, and more can be pooled among two or more systems, can be used locally or across larger areas. Sometimes, physical consolidation may be encouraged if the larger partnering system that takes over a smaller, troubled system is indemnified against enforcement action related to the smaller system's previous problems. Because larger systems typically have more technical expertise, economies of scale that enable more advanced treatment, and more purchasing power, the smaller system's customers can gain access to safer, more affordable water. Alternatively, a group of nearby small systems can join together to achieve economies of scale. For example, installing expensive treatment technologies for a system with only 300 ratepayers would impose great costs for each individual ratepayer. If several small systems consolidated, however, the cost of installation would be spread across a larger number of customers.

STRENGTHEN EXISTING DRINKING WATER REGULATIONS AND ESTABLISH NEW ONES.

Current drinking water regulations have some weaknesses. For example, the Lead and Copper Rule's sampling requirements have allowed some systems to minimize the likelihood of finding lead, and the rules for atrazine testing allow monitoring that could be timed to avoid finding a problem. These weaknesses, and others, must be addressed by the EPA.

In addition, there are untold numbers of unregulated contaminants in drinking water that pose health risks. The EPA must establish regulations for these contaminants, starting with perchlorate. Even though the EPA found that perchlorate can cause adverse health impacts—particularly on fetuses—and that it occurs in drinking water, the agency has not even proposed (much less finalized) a standard for this contaminant. Many more contaminants should be regulated, including perfluorinated compounds, cyanotoxins from harmful algal blooms, and Legionella.

Furthermore, the EPA must be allowed to improve and develop these regulations without unnecessary hurdles. Congressional Republicans, through the Regulatory Accountability Act (see below) and other legislation, seek to hinder any efforts to regulate pollution (among other things). This legislation must be stopped. The EPA has already delayed developing regulations; any more barriers and the imposition of a new set of cost-based supermandates would essentially halt the agency's work entirely.

IMPLEMENT A MORE ROBUST SYSTEM FOR DETECTING CONTAMINANTS

The levels of some contaminants will fluctuate with the seasons, so quarterly and annual sampling can miss peak contamination. Continuous monitoring would ensure that exceedances are identified in a timely fashion. Currently, no SDWA rules require continuous monitoring. While some technologies exist to continuously monitor for some chemicals in water, we need to research and develop more tools for monitoring both regulated and unregulated contaminants.

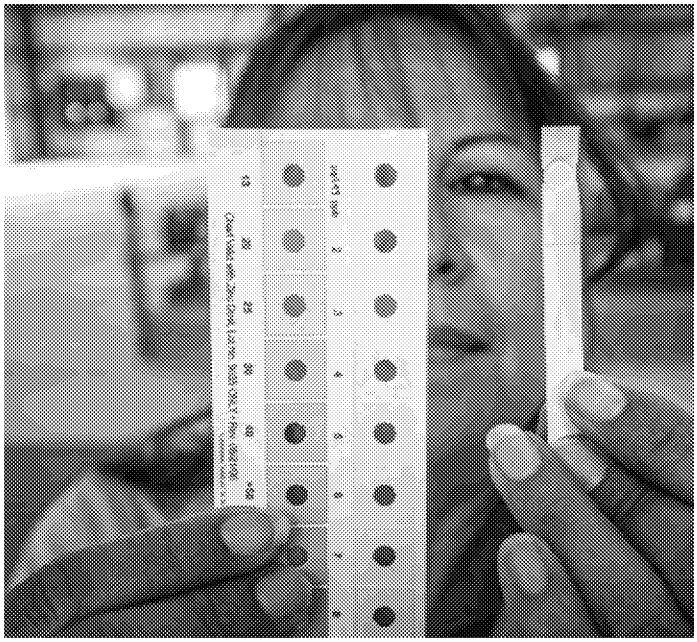
When continuous monitoring is not feasible, sampling should target the periods of time when contamination is most likely. Herbicides used during the spring, for example, should be sampled more frequently *after* they have been applied, not before.

There is currently a big gap in monitoring requirements for community water systems. Infants and children are far more sensitive and vulnerable to toxic chemicals, including those found in drinking water. For example, lead can irreversibly damage the developing brain and nervous system in infants and children. However, there are no requirements to test for lead or other drinking water contaminants in places where children spend much of their time: schools and day care facilities. These locations should be required to test for contaminants that can disproportionately impact children. At a minimum, schools and day care centers should be required to test for lead. Lead-contaminated drinking fountains should be immediately repaired or replaced.

We also need to create a national database of drinking water violations and lead service line locations, with easily accessible geographic information at the most specific scale possible to identify vulnerable areas and populations.

STRENGTHEN ALL DRINKING WATER ENFORCEMENT

Enforcement has been hobbled by poor funding, lack of state and federal management support, and agency officials' fear of political repercussions.[ab] For example, an EPA employee blew the whistle on Flint's lead crisis and urged aggressive action. An investigation by an independent task force established by the Michigan governor revealed that this employee was attacked by state officials for "acting outside of his authority."[71] Similarly, an EPA regional administrator in Chicago was widely reported as having been fired for being too aggressive in enforcing the law against Dow Chemical.[72] These kinds of reverberations are felt across the agency. We need to renew the enforcement culture at the EPA and primacy agencies to reinforce the importance of protecting public health.



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GIVE CITIZENS THE POWER TO MEANINGFULLY AND SWIFTLY RESPOND TO ENDANGERMENT OF THEIR HEALTH

The SDWA's citizen suit provision should be brought in line with those of the Clean Air Act and the Clean Water Act, which both allow citizen suits to seek penalties. Without such penalties, parties have no incentive to comply with the law until after court judgment is issued, something that can take many years. If penalties begin accumulating from the day the infraction first occurs, violators are more willing to quickly resolve the issue and come back into compliance to keep their ultimate costs low.

In addition, citizens whose water may carry an imminent and substantial health threat should be authorized to immediately sue for relief. Unlike the Resource Conservation and Recovery Act (RCRA), the current SDWA gives only the EPA, and not citizens, the authority to act in cases of emergency. For example, NRDC, ACLU-MI, and our clients had to petition the EPA to exercise its emergency authority in Flint. The agency took 112 days to respond, and even then, in the midst of a media and public firestorm, it issued an inadequate emergency order. Because of shortcomings in the SDWA, we could not directly challenge the water system, city, or state through an emergency legal action.[73] SDWA's imminent and substantial endangerment provision should be amended to allow citizens to bring emergency legal actions when they are facing health threats, rather than leaving them at the mercy of the EPA to take action.

ab The EPA's caution is perhaps partially due to the haranguing of the agency by conservative members of Congress over the past several years for supposed overreach or "overly aggressive" enforcement.

ENDNOTES

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Appendix A: Methods for Data Analysis

The goal of this analysis was to evaluate the number of community water systems in the United States that were in violation of federal drinking water laws under the Safe Drinking Water Act in calendar year 2015, and to calculate the numbers of people served by systems with violations. We accomplished this by performing a rule-by-rule analysis of violations in community water systems reported in calendar year 2015, using data downloaded from the U.S. Environmental Protection Agency's (EPA) Safe Drinking Water Act Information System. See below for a detailed description of methods used.

CALCULATIONS OF POPULATIONS AND SYSTEMS IMPACTED BY VIOLATIONS OF THE SAFE DRINKING WATER ACT

The Safe Drinking Water Information System is an EPA-maintained database that includes state-reported information about public water systems and their violations of federal drinking water laws. EPA regulations require primacy states[a] to report violations and enforcement actions to the EPA quarterly.[1] To calculate the populations and systems impacted by violations of the Safe Drinking Water Act, we downloaded drinking water data from the violations tab of the Quarter 3 2016 data set from the EPA Safe Drinking Water Information System on October 17, 2016.[2]

Data were limited to public water systems that were active in the Quarter 3 2016 data set and included systems with violations between January 1, 2015, and December 31, 2015. For systems with unresolved open violations (those with no fixed compliance period), data were downloaded from the Safe Drinking Water Information System for all open violations regardless of the violation start date. Data for community water systems with violations of the Safe Drinking Water Act were extracted from the original data through Microsoft Excel filtering tools. To remove duplicate entries for open violations, unique violation ID numbers were created for each system using a combination of the public water system identification (PWS ID) number and Violation ID fields in the Safe Drinking Water Information System. Safe Drinking Water Information System data fields include PWS ID, PWS Name, EPA Region, Primacy Agency, PWS Type, Primacy Type, Primary Source, Activity Status, Deactivation Date, Population Served Count, Rule Name, Violation Code, Violation Type, Violation Category Code, Is Health-Based, Contaminant Name, Compliance Period Begin Date, Compliance Period End Date, Compliance Status, Return to Compliance (RTC) Date, Enforcement Action Type Code, Enforcement Action Description, Is Major Violation, Severity Indicator Count, Public Notification Tier, Is School or Daycare, Violation ID, Unit of Measure, Unit of Measure Code, and Violation Measure. Each system and population was counted only once for total number of systems and population impacted.

To calculate the populations served and community water systems with violations of the individual rules (and all rules) of the Safe Drinking Water Act, rules were identified using the Rule Name data field in the downloaded Quarter 3 2016 data set of the Safe Drinking Water Information System. Values in the Rule Name field included Arsenic, Consumer Confidence Rule, Filter Backwash Rule, Ground Water Rule, Inorganic Chemicals, Lead and Copper Rule, Long Term 1 Enhanced Surface Water Treatment Rule, Long Term 2 Enhanced Surface Water Treatment Rule, Miscellaneous, Nitrates, Public Notice Rule, Radionuclides, Stage 1 Disinfectants and Disinfection Byproducts Rule, Stage 2 Disinfectants and Disinfection Byproducts Rule, Surface Water Treatment Rule, Synthetic Organic Chemicals, Total Coliform Rule, and Volatile Organic Chemicals. Calculations of the populations served and community water systems with violations of each rule were performed separately.

To calculate the populations served and number of community water systems with health-based violations of the individual rules (and all rules) of the Safe Drinking Water Act, all data for health-based violations were extracted using the Is Health-Based field. Rules with health-based violations were identified using the Rule Name data field in the downloaded Quarter 3 2016 data set of the Safe Drinking Water Information System. Values in the Rule Name field included Arsenic, Ground Water Rule, Inorganic Chemicals, Lead and Copper Rule, Long Term 1 Enhanced Surface Water Treatment Rule, Long Term 2 Enhanced Surface Water Treatment Rule, Nitrates, Radionuclides, Stage 1 Disinfectants and Disinfection Byproducts Rule, Stage 2 Disinfectants and Disinfection Byproducts Rule, Surface Water Treatment Rule, Synthetic Organic Chemicals, Total Coliform Rule, and Volatile Organic Chemicals. Calculations of the populations served and number of community water systems with violations of each rule were performed separately.

a Primacy or "primary enforcement responsibility" occurs when EPA has determined that a state, territory, or Tribe's rules are as strict as the federal standards and that they can and will enforce the Safe Drinking Water Act. Once a state is granted primacy, it receives substantial federal funding to carry out the law. All 50 states have primacy under the Safe Drinking Water Act, except Wyoming (which has chosen not to apply for it). The Navajo Nation is the only Indian tribe to have sought and received primacy; Puerto Rico and some other U.S. territories also have been approved for primacy. The District of Columbia does not have primacy.

GEOGRAPHIC REPRESENTATION OF POPULATIONS IMPACTED BY LEAD AND COPPER RULE VIOLATIONS AND ACTION LEVEL EXCEEDANCES

To map violations of the Safe Drinking Water Act, county-level information was obtained from the Geographic Area tab of the Quarter 3 2016 data set of the EPA Safe Drinking Water Information System. Violations were then mapped using the free and open-source geographic information system (GIS) software, QGIS. For systems with city-level information only, counties were identified through web searches for county locations or by joining X,Y coordinates for city locations with county layers in QGIS.

County- and state-level 20m-resolution cartographic boundary shape files for geographic visualization of drinking water violations were obtained from the 2015 U.S. Census Bureau's Master Address File/Topologically Integrated Geographic Encoding and Referencing (MAF/TIGER) system.[b]

For Figure 1, populations impacted by violations of the Safe Drinking Water Act in each county were calculated by grouping violating systems by county and summing the populations for each violating system. For systems serving multiple counties, populations impacted by violations or action level exceedances were included in the population totals for each county served. Populations were not double-counted for aggregate populations impacted (i.e., total U.S. population served by systems with health-based violations of the Safe Drinking Water Act.

Violations in Figures 1, 1.1, 2.1, 3.1, 4.1, 5.1, 6.1, 7.1, 8.1, 9.1, 10.1, 11.1, and 12.1 include both monitoring and reporting and treatment technique violations. Specific violation types include Monitoring, Regular; Monitoring and Reporting (DBP); Consumer Confidence Report Complete Failure to Report; Consumer Confidence Report Inadequate Reporting; Follow-up Or Routine LCR Tap M/R; Maximum Contaminant Level Violation, Monthly (TCR); Maximum Contaminant Level Violation, Single Sample; Monitoring, Repeat Major (TCR); Monitoring, Routine Minor (TCR); Monitoring, Source Water (GWR); Monitoring, Routine Major (TCR); Maximum Contaminant Level Violation, Average; Maximum Contaminant Level Violation, Acute (TCR); Monitoring, Repeat Minor (TCR); Initial Tap Sampling for Pb and Cu; Lead Consumer Notice; Public Education; Failure To Address Deficiency; Treatment Technique (SWTR and GWR); Single Turbidity Exceed (Enhanced SWTR); Monitoring of Treatment (SWTR-Filter); Treatment Technique No Certif. Operator; Failure to Filter (SWTR); Failure Submit Filter Profile/CPE Report; Treatment Technique Precursor Removal; Failure to Consult with State; Public Notification Violation for NPDWR Violation; Monitoring, Routine (IDSE); Sanitary Survey (TCR); Monitoring, Turbidity (Enhanced SWTR); Monitoring of Treatment (SWTR-Unfilt/GWR); Monthly Turbidity Exceed (Enhanced SWTR); OCCT/SOWT Study/Recommendation; OCCT/SOWT Treatment Installation/Demonstration; Failure Submit IDSE/Subpart V Plan Rpt; Monitoring, Source Water (LT2); Failure to Notify Other PWS; Water Quality Parameter M/R; Record Keeping; Failure Submit Treatment Requirement Rpt; MPL Non-Compliance; Initial, Follow-up, or Routine Source Water M/R; Monitoring, Check/Repeat/Confirmation; Variance/Exemption/Other Compliance; Public Notification Violation without NPDWR Violation; Notification, State; Treatment Tech. No Prior State Approval; Failure to Conduct Assessment Monitoring; Lead Service Line Replacement (LSLR); Non-Acute MRDL; Acute Maximum Residual Disinfectant Level; Treatment Technique Uncovered Reservoir; WQP Entry Point/Tap Treatment Technique Non-Compliance; Monitoring and Reporting (FBRR).

For Figures 2, 1.2, 2.2, 3.2, 4.2, 5.2, 6.2, 7.2, 8.2, 9.2, and 10.2 , populations impacted by health-based violations of the Safe Drinking Water Act in each county were calculated by grouping violating community systems by county and summing the populations for each violating system. For systems serving multiple counties, populations impacted by violations or action level exceedances were included in the population totals for each county served. Populations were not double-counted for aggregate populations impacted (i.e., total U.S. population served by systems with health-based violations of the Safe Drinking Water Act).

Violations reflected in Figures 2, 1.2, 2.2, 3.2, 4.2, 5.2, 6.2, 7.2, 8.2, 9.2, and 10.2are subsets of the violations in Figures 1, 1.1, 2.1, 3.1, 4.1, 5.1, 6.1, 7.1, 8.1, 9.1, 10.1, 11.1, and 12.1 and include only those violations designated as health-based in the Is Health-Based field. Specific violation types include Maximum Contaminant Level Violation, Monthly (TCR); Maximum Contaminant Level Violation, Single Sample; Maximum Contaminant Level Violation, Average; Maximum Contaminant Level Violation, Acute (TCR); Public Education; Failure To Address Deficiency; Treatment Technique (SWTR and GWR); Single Turbidity Exceed (Enhanced SWTR); Treatment Technique No Certif. Operator; Failure to Filter (SWTR); Treatment Technique Precursor Removal; Monthly Turbidity Exceed (Enhanced SWTR); OCCT/SOWT Study/Recommendation; OCCT/SOWT Treatment Installation/Demonstration; Failure Submit Treatment Requirement Rpt; MPL Non-Compliance; Treatment Tech. No Prior State Approval; Lead Service Line Replacement (LSLR); Non-Acute MRDL; Acute Maximum Residual Disinfectant Level; Treatment Technique Uncovered Reservoir; and WQP Entry Point/Tap Treatment Technique Non-Compliance.

b 20m indicates a 1:20,000,000 resolution level shapefile.

Populations served by systems with unobtainable county-level information (e.g., some tribal lands) were not included in the mapped populations impacted, but the populations were included in the aggregate population- and system-level totals (e.g., total number of community water systems or total U.S. population impacted by violations of the Safe Drinking Water Act).

CALCULATIONS OF ENFORCEMENT ACTIONS AND COMPLIANCE RATES FOR SYSTEMS IN VIOLATION OF THE SAFE DRINKING WATER ACT

Enforcement actions were obtained from the Enforcement Action Description field of the Safe Drinking Water Information System. Enforcement actions taken between January 1, 2015, and December 31, 2015, included Federal Complaint for Penalty Consent Order or Consent Decree, Federal Proposed Administrative Order Issued, Federal Complaint for Penalty issued, Federal issued Formal Notice of Violation, Federal Final Administrative Order issued, Federal Consent Decree/Judgement, Federal no additional Formal Action needed, Federal Compliance achieved, Federal Variance/Exemption issued, State Civil Case concluded, State Case appealed, State Case dropped, State Hook-up/Extension Ban, State Public Notif issued, State Formal Notice of Violation issued, State Bilateral Compliance Agreement signed, State Administrative/Compliance Order without penalty issued, State Administrative Penalty assessed, State Show-Cause hearing, State Administrative/Compliance Order with penalty issued, State Civil Case under development, State Civil Case filed in State court, State Consent Decree/Judgement, State Violation/Reminder Notice, State Compliance Meeting conducted, State Technical Assistance Visit, State Site Visit for enforcement purposes, State Public Notification requested, State Public Notification received, State no additional Formal Action needed, State Intentional no-action, State Other, State Compliance achieved, and State Variance/Exemption issued. Enforcement action totals were calculated using Microsoft Excel PivotTables.

To differentiate between formal and informal enforcement actions, formal enforcement actions were identified using definitions established in the 2009 EPA document "Proposed Revision to Enforcement Response Policy for the Public Water System Supervision (PWSS) Program Under the Safe Drinking Water Act and Implementation of the Enforcement Targeting Tool."[c]

ENDNOTES

1 See 40 CFR 142.15(a).

2 U.S. Environmental Protection Agency. "Safe Drinking Water Information System (SDWIS) Federal Reporting Services," https://www.epa.gov/your-drinking-water/safe-drinking-water-information-system-sdwis-federal-reporting-services.

c This document can be found at https://www.epa.gov/sites/production/files/documents/drinking_water_erp_2009.pdf.

Appendix B: State Rankings by Population

TABLE 5

States Ranked by Populations Served by Community Water Systems with Safe Drinking Water Act Violations in 2015[a]

Note that NRDC has obtained these data directly from the EPA's Safe Drinking Water Information System, which the agency compiles from data submitted by state regulators in accordance with EPA rules. NRDC has not independently verified these data.[b]

RANK	STATE OR TERRITORY	TOTAL NUMBER OF VIOLATIONS OF THE SDWA	TOTAL POPULATION SERVED BY COMMUNITY WATER SYSTEMS WITH VIOLATIONS OF THE SDWA	TOTAL NUMBER OF COMMUNITY WATER SYSTEMS WITH VIOLATIONS OF THE SDWA	TOTAL STATE OR TERRITORY POPULATION IN 2015 (U.S. CENSUS)[b]	PERCENT OF STATE OR TERRITORY POPULATION SERVED BY COMMUNITY WATER SYSTEMS WITH VIOLATIONS OF THE SDWA
1	TX	13,913	12,066,920	2,507	27,469,114	43.9%
2	FL	1,653	7,540,465	757	20,271,272	37.2%
3	PA	7,643	5,645,903	978	12,802,503	44.1%
4	NJ	1,062	4,487,703	234	8,958,013	50.1%
5	GA	1,870	3,846,734	906	10,214,860	37.7%
6	PR	3,502	3,456,835	374	3,474,182	99.5%
7	WA	2,086	2,989,165	683	7,170,351	41.7%
8	OH	533	2,958,414	293	11,613,423	25.5%
9	CA	1,914	2,566,008	832	39,144,818	6.6%
10	AZ	2,362	2,455,076	572	6,828,065	36.0%
11	KY	832	2,346,782	234	4,425,092	53.0%
12	WI	1,397	2,211,533	445	5,771,337	38.3%
13	MD	268	2,185,978	118	6,006,401	36.4%
14	LA	2,108	1,918,235	436	4,670,724	41.1%
15	MA	578	1,800,318	163	6,794,422	26.5%
16	NY	1,748	1,622,861	637	19,795,791	8.2%
17	OK	4,832	1,454,261	665	3,911,338	37.2%
18	CT	768	1,440,793	216	3,590,886	40.1%
19	NC	2,025	1,059,513	464	10,042,802	10.5%
20	UT	1,354	908,219	256	2,995,919	30.3%
21	TN	285	877,685	116	6,600,299	13.3%
22	IL	421	778,666	192	12,859,995	6.1%
23	WV	5,715	740,170	310	1,844,128	40.1%
24	IN	913	694,423	235	6,619,680	10.5%
25	SC	187	684,838	111	4,896,146	14.0%

a Data for January 1, 2015, to December 31, 2015, from the 2016 quarter 3 data set of the EPA Safe Drinking Water Information System (SDWIS); available at https://ofmpub.epa.gov/apex/sfdw/f?p=108:200:::::.

b Population information from the Annual Estimates of the Resident Population for the United States, Regions, States, and Puerto Rico: April 1, 2010, to July 1, 2015 (NST-EST2015-01), U.S. Census Bureau, Population Division.

RANK	STATE OR TERRITORY	TOTAL NUMBER OF VIOLATIONS OF THE SDWA	TOTAL POPULATION SERVED BY COMMUNITY WATER SYSTEMS WITH VIOLATIONS OF THE SDWA	TOTAL NUMBER OF COMMUNITY WATER SYSTEMS WITH VIOLATIONS OF THE SDWA	TOTAL STATE OR TERRITORY POPULATION IN 2015 (U.S. CENSUS)[a]	PERCENT OF STATE OR TERRITORY POPULATION SERVED BY COMMUNITY WATER SYSTEMS WITH VIOLATIONS OF THE SDWA
26	MO	1,502	677,800	540	6,083,672	11.1%
27	DE	241	579,263	97	945,934	61.2%
28	AL	121	566,792	48	4,858,979	11.7%
29	OR	1,273	565,655	362	4,028,977	14.0%
30	MI	413	532,788	195	9,922,576	5.4%
31	AR	510	508,183	230	2,978,204	17.1%
32	CO	1,061	492,865	269	5,456,574	9.0%
33	KS	811	464,280	326	2,911,641	15.9%
34	NM	1,291	426,332	326	2,085,109	20.4%
35	IA	315	362,632	164	3,123,899	11.6%
36	VA	709	348,871	231	8,382,993	4.2%
37	ID	796	325,575	283	1,654,930	19.7%
38	MS	284	303,618	100	2,992,333	10.1%
39	AK	2,943	196,713	278	738,432	26.6%
40	NE	325	175,245	180	1,896,190	9.2%
41	MT	1,248	173,661	313	1,032,949	16.8%
42	ME	446	160,507	177	1,329,328	12.1%
43	NV	359	121,069	55	2,890,845	4.2%
44	WY	357	118,481	116	586,107	20.2%
45	RI	61	108,089	23	1,056,298	10.2%
46	VT	492	92,080	182	626,042	14.7%
47	HI	15	70,352	6	1,431,603	4.9%
48	MN	141	69,349	90	5,489,594	1.3%
49	NH	644	66,131	126	1,330,608	5.0%
50	AS[c]	1,968	60,012	17	not available	not available
51	ND	402	56,726	118	756,927	7.5%
52	SD	302	54,314	123	858,469	6.3%
53	MP[d]	44	53,545	19	not available	not available
54	DC	5	28,189	2	672,228	4.2%
55	GU[e]	9	22,000	1	not available	not available
56	VI[f]	152	7,075	56	not available	not available

c AS = American Samoa
d MP = Northern Marianas
e GU = Guam
f VI = Virgin Islands

Appendix C: State Rankings by Population (Health-Based Violations Only)

TABLE 5

States Ranked by Populations Served by Community Water Systems with Health-Based Safe Drinking Water Act Violations in 2015[a]

Note that NRDC has obtained these data directly from EPA's Safe Drinking Water Information System, which the Agency compiles from data submitted by state regulators in accordance with EPA rules. NRDC has not independently verified these data.

RANK	STATE OR TERRITORY	TOTAL NUMBER OF VIOLATIONS OF THE SDWA	TOTAL POPULATION SERVED BY COMMUNITY WATER SYSTEMS WITH VIOLATIONS OF THE SDWA	TOTAL NUMBER OF COMMUNITY WATER SYSTEMS WITH VIOLATIONS OF THE SDWA	TOTAL STATE OR TERRITORY POPULATION IN 2015 (U.S. CENSUS)[b]	PERCENT OF STATE OR TERRITORY POPULATION SERVED BY COMMUNITY WATER SYSTEMS WITH VIOLATIONS OF THE SDWA
1	TX	1,950	4,970,249	561	27,469,114	18.1%
2	PR	545	2,410,809	201	3,474,182	69.4%
3	OH	116	2,315,260	68	11,613,423	19.9%
4	MD	41	1,754,409	26	6,006,401	29.2%
5	KY	217	1,513,617	96	4,425,092	34.2%
6	FL	253	1,501,883	128	20,271,272	7.4%
7	CA	1,006	1,476,159	389	39,144,818	3.8%
8	LA	419	1,031,504	167	4,670,724	22.1%
9	WA	70	943,848	42	7,170,351	13.2%
10	OK	1,584	823,882	329	3,911,338	21.1%
11	NJ	58	775,640	35	8,958,013	8.7%
12	NY	232	706,910	125	19,795,791	3.6%
13	PA	302	691,256	167	12,802,503	5.4%
14	SC	77	430,344	37	4,896,146	8.8%
15	MA	106	427,383	63	6,794,422	6.3%
16	UT	109	421,320	83	2,995,919	14.1%
17	MO	403	377,056	220	6,083,672	6.2%
18	AR	234	347,220	127	2,978,204	11.7%
19	WI	132	335,079	68	5,771,337	5.8%
20	GA	189	317,551	82	10,214,860	3.1%
21	NC	157	304,670	92	10,042,802	3.0%
22	IL	131	278,882	63	12,859,995	2.2%
23	IN	133	243,087	63	6,619,680	3.7%
24	TN	59	237,759	30	6,600,299	3.6%
25	AZ	152	219,044	73	6,828,065	3.2%

a Data for January 1, 2015, to December 31, 2015, from the 2016 quarter 3 data set of the EPA Safe Drinking Water Information System (SDWIS), available at https://ofmpub.epa.gov/apex/sfdw/f?p=108:200:::::.

b Population information from the Annual Estimates of the Resident Population for the United States, Regions, States, and Puerto Rico: April 1, 2010, to July 1, 2015 (NST-EST2015-01), U.S. Census Bureau, Population Division.

RANK	STATE OR TERRITORY	TOTAL NUMBER OF VIOLATIONS OF THE SDWA	TOTAL POPULATION SERVED BY COMMUNITY WATER SYSTEMS WITH VIOLATIONS OF THE SDWA	TOTAL NUMBER OF COMMUNITY WATER SYSTEMS WITH VIOLATIONS OF THE SDWA	TOTAL STATE OR TERRITORY POPULATION IN 2015 (U.S. CENSUS)[b]	PERCENT OF STATE OR TERRITORY POPULATION SERVED BY COMMUNITY WATER SYSTEMS WITH VIOLATIONS OF THE SDWA
26	KS	267	217,994	123	2,911,641	7.5%
27	MS	114	207,014	59	2,992,333	6.9%
28	WV	109	204,555	58	1,844,128	11.1%
29	MI	98	196,446	63	9,922,576	2.0%
30	IA	106	180,096	53	3,123,899	5.8%
31	VA	156	170,049	85	8,382,993	2.0%
32	NE	270	162,175	144	1,896,190	8.6%
33	NM	453	149,161	132	2,085,109	7.2%
34	AL	14	142,437	8	4,858,979	2.9%
35	OR	191	117,341	94	4,028,977	2.9%
36	ID	217	93,702	95	1,654,930	5.7%
37	MT	177	84,185	93	1,032,949	8.1%
38	AK	298	83,702	114	738,432	11.3%
39	HI	10	69,702	5	1,431,603	4.9%
40	CO	198	67,369	105	5,456,574	1.2%
41	AS[c]	15	57,292	9	not available	not available
42	CT	70	53,915	40	3,590,886	1.5%
43	NV	60	27,680	25	2,890,845	1.0%
44	SD	108	24,124	72	858,469	2.8%
45	WY	39	23,998	23	586,107	4.1%
46	RI	7	22,794	5	1,056,298	2.2%
47	NH	92	22,645	45	1,330,608	1.7%
48	MN	28	16,358	22	5,489,594	0.3%
49	VT	60	11,874	48	626,042	1.9%
50	ME	41	8,725	27	1,329,328	0.7%
51	DE	19	6,123	12	945,934	0.6%
52	MP[d]	3	1,472	3	not available	not available
53	VI[e]	8	488	7	not available	not available

c AS = American Samoa
d MP = Northern Marianas
e GU = Guam

Appendix 1: Disinfection Byproducts

- Exposure can lead to cancer and potentially to reproductive impacts such as miscarriages and birth defects.
- In 2015, there were 11,311 violations of EPA standards (4,591 health-based) at community water systems serving 25,173,431 people (12,584,936 served by systems with health-based violations).
- Formal enforcement measures were taken in 12.4 percent of all cases and 23.0 percent of health-based cases.
- Less than one-fouth of the violations (and more than one out of every eight of the health-based violations) returned to compliance within the calendar year.

BACKGROUND

Before World War I, drinking water often contained bacteria that caused diseases like cholera and typhoid.[1] These bacteria can come from polluted sources of drinking water like lakes and rivers.[2]

The practice of disinfecting drinking water with chlorine, which became widespread after World War I in the United States, led to a dramatic reduction in waterborne disease from pathogens in drinking water.[3] For example, in 1900 there were 100 cases of typhoid fever per 100,000 people; by 2006 that number had dropped to fewer than 0.1 cases in 100,000 people.[4]

In addition to using chlorine or another disinfectant to kill pathogens in the water at treatment plants, water suppliers also need to protect the drinking water after it leaves the plant and moves through the pipes in the distribution system on the way to customers. In fact, public water utilities are now required by U.S. Environmental Protection Agency (EPA) rules to maintain a residual amount of a disinfectant (called a "residual disinfectant") throughout the water system's pipes.[5]

While adding chlorine (the most common chemical used for disinfection) or other chemical disinfectants to water has obvious benefits, these disinfectants can create byproducts that can adversely impact human health.[6] When chlorine is added to water, it reacts with naturally occurring organic material found in the source water, often present due to the breakdown of leaves or mud in the water.[7] That reaction creates "disinfection byproducts," including categories of chemicals called trihalomethanes (THMs) and haloacetic acids (HAAs).[8] When ozone is used as a disinfectant in water containing naturally occurring bromine, it can create bromate, a likely carcinogen.[9,10] When chlorine dioxide is used as a disinfectant, it can create chlorite, which the EPA has found may increase the risk of anemia, and nervous system effects in infants and young children.[11,12]

Water systems can reduce or eliminate the creation of these disinfection byproducts by being careful about how much of the chemicals they use, carefully controlling how they add them, and/or by pretreating their water to remove the organic matter or other precursors that would otherwise react with the chlorine or other disinfectants to create these risky disinfection byproducts.[13] They also can switch to more advanced disinfectants, such as ozone (if they have low bromine levels in their water) or ultraviolet light, and by using chloramines as a residual disinfectant.[14]

HEALTH EFFECTS OF DISINFECTION BYPRODUCTS AND EPA'S RULES

Scientific research raised concerns that exposure to some disinfection byproducts may cause cancer or reproductive problems. For example, a series of epidemiological studies of people whose tap water contained disinfection byproducts found an association between some cancers such as bladder cancer and exposure to some of these chemicals. Laboratory studies with animals also found a link between the occurrence of cancer and exposure to some of these byproducts.[15] Moreover, a series of preliminary studies showed associations between some disinfection byproducts and certain birth defects, miscarriages, and other possible adverse reproductive impacts.[16]

In order to help address these risks, the EPA has regulated disinfection byproducts in drinking water since 1979.[17] In 1998, as evidence mounted that these chemicals could pose serious health risks at the levels allowed by the EPA, the agency added limits for new disinfection byproducts, tightened the existing limits, and expanded the number of systems that were required to comply with it to minimize the risk through the Disinfectant and Disinfection Byproduct Rule (DDBP). Under the rule, the EPA established health standards for disinfection byproducts that apply to all community water systems that add disinfectants to their water. (As discussed in a later appendix on the Groundwater Rule, some groundwater-supplied water systems are not required to disinfect and therefore are not required to test for disinfection byproducts.)

The EPA developed this rule over two stages.[18] Stage 1 of the DDBP, finalized in 1998, sought to reduce the exposure to disinfection byproducts through drinking water.[19] It established a stricter maximum contaminant level (MCL) for total THMs (rather than for each individual trihalomethane), as well as new MCLs for five haloacetic acids (HAA5), bromate (for systems that use ozone to disinfect), and chlorite (for systems that use chlorine dioxide to disinfect).[20] Stage 1 also established maximum residual disinfection levels (MRDLs) for chlorine, chloramine, and chlorine dioxide.[21] Stage 2 of the DDBP, finalized in 2006, tightened the monitoring requirements for total THMs and HAA5 (effectively also driving down allowable levels of disinfection byproducts in tap water, because peak levels would now be more likely to be detected); the new rule targeted the public water systems at greatest risk but did not change the other sections of Stage 1.[22]

For example, under Stage 1, a system serving between 50,000 and 249,999 people was required to monitor for total THMs and HHA5 at four locations per treatment plant each quarter.[23] Under Stage 2, that same system now has to monitor at eight locations per quarter.[24] Similarly, under Stage 1, the largest systems (those serving more than 5 million people) had to monitor at only four locations, but under Stage 2 that requirement increased to 20 locations.[25] The frequency of monitoring varies depending on the size and type of system as well as the type of disinfectant.[26]

Because the reaction of a disinfectant with organic materials creates byproducts, the rule also required certain systems to remove organic materials (measured as total organic carbon, or TOC) from the water.[27] That requirement could be met either by reducing a certain percentage of the TOC or through a treatment technique (enhanced coagulation or enhanced softening).[28]

ALL VIOLATIONS

In 2015, there were 11,311 violations of the Stage 1 and/or Stage 2 Disinfectants and Disinfection Byproducts Rules by 4,433 community water systems across the country. The systems in violation served 25,173,431 people. These include violations of the maximum contaminant level, as well as failures to comply with the rules' monitoring and reporting requirements.

All states except Washington reported community water systems with violations of the Stage 1 and/or Stage 2 Disinfectants and Disinfection Byproducts Rules. The states or territories with the largest populations served by systems with violations were:[a]

- Texas (3,118,015 people served)
- Pennsylvania (2,977,203 people served)
- Puerto Rico (2,573,277 people served)
- Florida (1,935,002 people served)
- Maryland (1,794,458 people served)

When ranked by percentage of population served by community water systems with violations of the Stage 1 and/or Stage 2 Disinfectants and Disinfection Byproducts Rules, Puerto Rico ranked the highest, with 74.1 percent of its population served by systems in violation.[b]

HEALTH-BASED VIOLATIONS

In 2015, there were 4,591 health-based violations of the Stage 1 and/or Stage 2 Disinfectants and Disinfection Byproducts Rules by 1,552 community water systems across the country. The systems in violation served 12,584,936 people.

All states except Washington, Rhode Island, and Utah had community water systems with health-based violations of the Stage 1 and/or Stage 2 Disinfectants and Disinfection Byproducts Rules in 2015. The states or territories having the highest populations served by violating systems were:[c]

- Puerto Rico (2,179,838 people served)
- Maryland (1,747,189 people served)
- Texas (1,597,845 people served)
- Kentucky (1,290,144 people served)
- Oklahoma (600,807 people served)

a The District of Columbia, Guam, and the Virgin Islands also had no community water systems with reported violations of the Stage 1 and/or Stage 2 Disinfectants and Disinfection Byproducts Rules in calendar year 2015.

b In 2015, the estimated population of Puerto Rico was 3,474,182 people (from the Annual Estimates of the Resident Population for the United States, Regions, States, and Puerto Rico: April 1, 2010 to July 1, 2015 (NST-EST2015-01); U.S. Census Bureau, Population Division).

c The District of Columbia, Guam, and the Virgin Islands also had no community water systems with health-based violations of the Stage 1 and/or Stage 2 Disinfectants and Disinfection Byproducts Rules in calendar year 2015.

FIGURE 1.1: 25.2 MILLION PEOPLE SERVED BY COMMUNITY WATER SYSTEMS WITH AT LEAST ONE REPORTED VIOLATION OF THE STAGE 1 AN D/OR STAGE 2 DISINFECTANTS AND DISINFECTION BYPRODUCTS RULES (2015). POPULATIONS ARE SHADED AT THE COUNTY LEVEL TO SHOW NUMBER OF RESIDENTS SERVED BY COMMUNITY WATER SYSTEMS WITH VIOLATION(S) IN 2015.

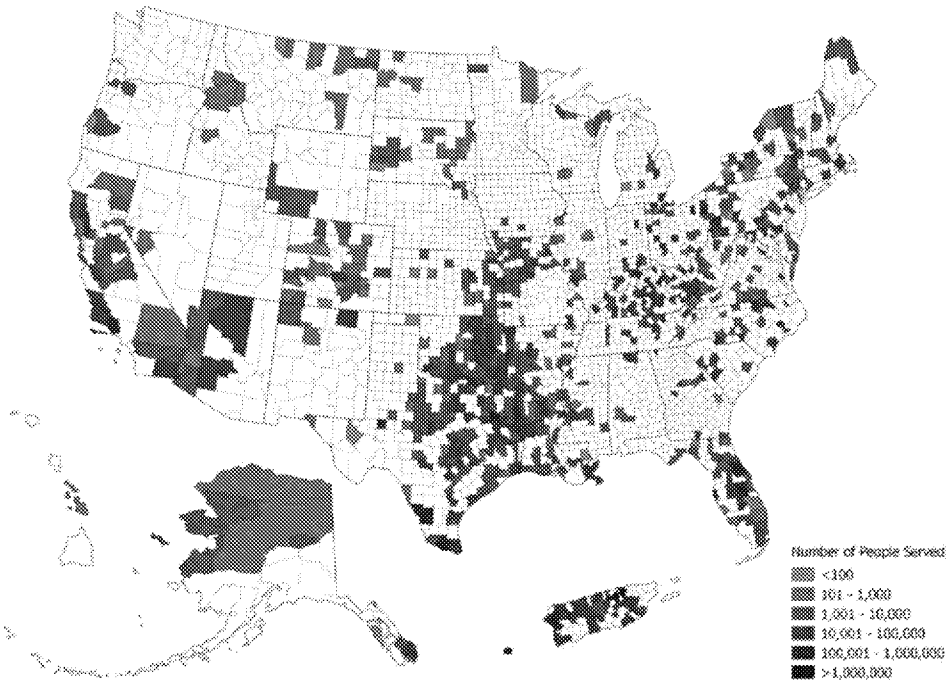
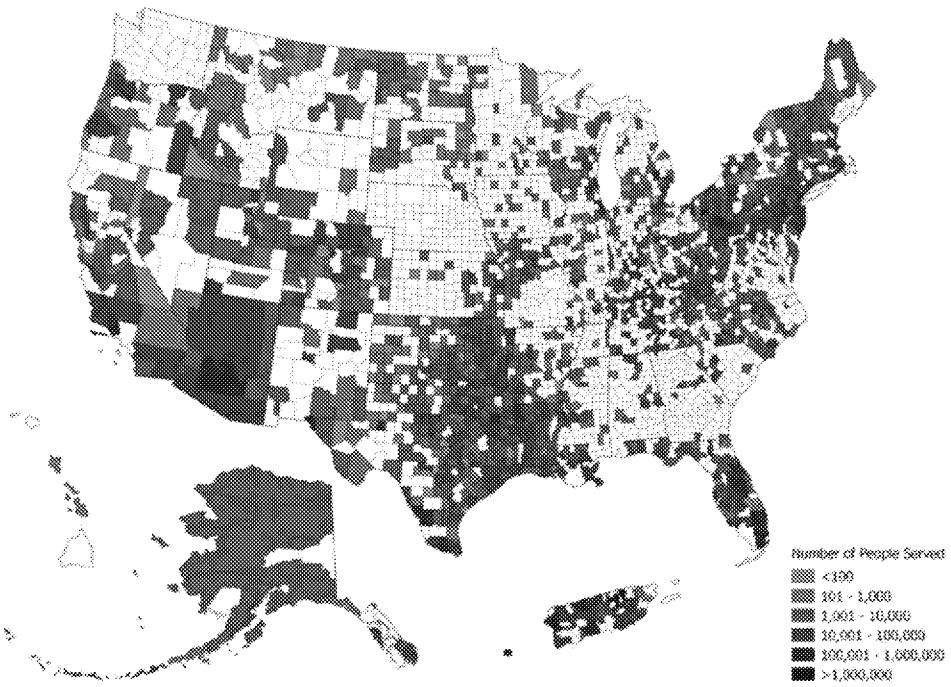


FIGURE 1.:. 12.6 MILLION PEOPLE SERVED BY COMMUNITY WATER SYSTEMS WITH AT LEAST ONE REPORTED HEALTH-BASED VIOLATION OF THE STAGE 1 AND/OR STAGE 2 DISINFECTANTS AND DISINFECTION BYPRODUCTS RULES (2015). POPULATIONS ARE SHADED AT THE COUNTY LEVEL TO SHOW NUMBER OF RESIDENTS SERVED BY COMMUNITY WATER SYSTEMS WITH VIOLATION(S) IN 2015.



When ranked by percentage of population served by community water systems with health-based violations of the Stage 1 and/or Stage 2 Disinfectants and Disinfection Byproducts Rules, Puerto Rico ranked the highest, with 62.7 percent of its population served by systems in violation.[d]

ENFORCEMENT

Of the 11,311 reported violations of the Stage 1 and/or Stage 2 Disinfectants and Disinfection Byproducts Rules, formal enforcement action was taken by the EPA or the states in 12.4 percent of cases.e Less than one-fourth of the violations (2,749 violations) returned to compliance within the calendar year.

For health-based violations of the Stage 1 and/or Stage 2 disinfection byproducts rule, formal enforcement action was taken by the EPA or the states in 23.0 percent of the 4,591 cases reported in 2015.[f] A little more than one out of every eight health-based violations (13.4 percent; 614 violations) returned to compliance within the calendar year.

TABLE 1.1 VIOLATIONS OF STAGE 1 AND/OR STAGE 2 DISINFECTANTS AND DISINFECTION BYPRODUCTS RULES IN CALENDAR YEAR 2015, RANKED BY POPULATION SERVED[g]

RULE	POPULATION SERVED	NUMBER OF VIOLATIONS	NUMBER OF SYSTEMS
Stage 2 Disinfectants and Disinfection Byproducts Rules	19,437,540	7,670	2,529
Stage 1 Disinfectants and Disinfection Byproducts Rules	8,527,072	3,641	2,224
Total[h]	25,173,431	11,311	4,433
HEALTH-BASED VIOLATIONS ONLY			
Stage 2 Disinfectants and Disinfection Byproducts Rules	11,782,187	4,187	1,341
Stage 1 Disinfectants and Disinfection Byproducts Rules	2,220,041	404	251
Total[i]	12,584,936	4,591	1,552

d In 2015, the estimated population of Puerto Rico was 3,474,182 people (from the Annual Estimates of the Resident Population for the United States, Regions, States, and Puerto Rico: April 1, 2010, to July 1, 2015 (NST-EST2015-01); U.S. Census Bureau, Population Division).

e Formal enforcement action was taken for 1,407 violations out of the total 11,311 violations of the Stage 1 and/or Stage 2 Disinfectants and Disinfection Byproducts Rules in calendar year 2015. The federal government was responsible for 5.3 percent of formal enforcement actions (74 violations), and states were responsible for 94.7 percent (1,333 violations). Any enforcement action (including formal and informal actions) was taken in 95.9 percent of cases (10,844 actions for 11,311 violations).

f Formal enforcement action was taken for 1,055 health-based violations of the Stage 1 and Stage 2 Disinfectants and Disinfection Byproducts Rules in calendar year 2015. The federal government was responsible for 3.6 percent of formal enforcement actions (38 violations), and states were responsible for 96.4 percent (1,017 violations). Any enforcement action (including formal and informal actions) was taken in 98.2 percent of cases (4,507 violations).

g Data are from the 2016 quarter 3 data set of the Safe Drinking Water Information System.

h Populations served by systems with violations of both the Stage 1 and Stage 2 Disinfectants and Disinfection Byproducts Rules were counted only once, resulting in a smaller total population served for the combined rules than the rules tallied individually.

i Populations served by systems with health-based violations of both the Stage 1 and Stage 2 Disinfectants and Disinfection Byproducts Rules were counted only once, resulting in a smaller total population served for the combined rules than the rules tallied individually.

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Appendix 2: Total Coliform Rule

- The presence of the family of bacteria called coliforms in drinking water. These organisms can cause diarrhea, cramps, nausea, and headaches, as well as potentially more serious health threats in children, the elderly, and immune-compromised people who cannot fight off infections.
- In 2015, there were 10,261 violations (2,574 health-based) at community water systems serving 17,768,807 people (10,118,586 health-based).
- Formal enforcement was taken in 8.8 percent of cases (and 8.3 percent of health-based cases).
- A little less than half of the violations (and health-based violations) returned to compliance within the calendar year.

BACKGROUND

Coliform refers to a family of bacteria that are common in soils, plants, and animals.[1] While most coliforms are not harmful to humans, an abundance of them in drinking water may indicate the presence of harmful pathogens that can cause health problems when ingested.[2] For example, one member of the coliform family is *Escherichia coli* (*E. coli*), found in the intestinal tracts of warm-blooded mammals such as humans.[3] The presence of fecal coliforms in drinking water indicates that fresh fecal waste is or has been present, which is a cause for concern because several diseases can be spread through fecal transmission.[4] The presence of coliforms can also be an indication that there is a problem within the water treatment plant or the water distribution system.[5] For example, if a water storage tank has a hole that animals can get into, that could be a source of excess coliforms, including *E. coli*.

HEALTH EFFECTS OF TOTAL COLIFORMS

Coliforms in drinking water do not necessarily make people ill. However, a subset of these organisms can cause illness.[6] Furthermore, coliforms can be a good indication of the presence of other organisms that can cause disease.[7] Health symptoms related to drinking or swallowing water contaminated with coliforms include diarrhea, cramps, nausea, and headaches, among others.[8] Bacteria, viruses, and parasites present in contaminated water may pose a special health risk for infants, young children, the elderly, and people with severely compromised immune systems.[9]

EPA REGULATION OF TOTAL COLIFORMS

The Total Coliform Rule was promulgated in 1989 and became effective in 1990.[10] The rule set a maximum contaminant level goal (MCLG) and maximum contaminant levels (MCLs) for the presence of total coliforms in drinking water.[11] The U.S. Environmental Protection Agency (EPA) set the MCLG for total coliforms at zero because waterborne disease outbreaks had been found to occur at very low levels of coliform presence.[12] The agency created two tiers of MCL violations based on positive sample tests for total coliforms, fecal coliforms, and/or *E. coli*.[13]

The Total Coliform Rule required public water systems to collect routine samples monthly, quarterly, or annually, depending on the size of the system and whether its location made it vulnerable to contamination.[14] If any routine sample tested positive for total coliform, then it had to be tested for fecal coliform or *E. coli* as well.[15] The water system was also required to take another set of samples, within 24 hours, at locations near the site that tested positive (repeat samples). As with the routine samples, if the repeat samples tested positive for total coliform, then they also had to be tested for fecal coliform or *E. coli*.[16]

Under the 1990 Rule, there were two kinds of MCL violations: monthly MCL and acute MCL. If more than 5 percent of the routine or repeat samples tested positive for total coliform, it was a monthly MCL violation. An acute MCL violation occurred if a) a repeat sample tested positive for fecal coliform or E. coli, or b) a routine sample tested positive for fecal coliform or *E. coli* and the repeat sample tested positive for total coliform.[17]

Monthly MCL violations had to be reported to the state by the end of the next business day, and to the public within 30 days.[18] Acute MCL violations had to be reported to the state and the public within 24 hours. (Because this represents a direct health risk, the state and public were required to be notified immediately.) There were also times when a positive test for fecal coliform or *E. coli* required a boil-water notice.[19]

For systems on a quarterly or annual routine sampling schedule, systems were required to collect at least three additional routine samples in the month after a sample tested positive for total coliforms.[20]

In 2013, the EPA published the Revised Total Coliform Rule.[21] All public water systems, except aircraft systems subject to the Aircraft Drinking Water Rule, were required to comply with the revised rule by April 1, 2016.[22] Under the revised rule, EPA established an MCLG of zero and an MCL, which describes the occurrence of positive sample tests for *E. coli*—a more specific indicator of potential harmful pathogens.[23] It replaced the MCLG and MCL for total coliforms with a treatment technique requiring a system to assess the source of the problem within the distribution system and to take corrective action based on that assessment.[24] The Revised Total Coliform Rule maintains a routine sampling structure for public water systems. The data in this report are from 2015; therefore they reflect violations of the original Total Coliform Rule, not the revised rule.[25]

ALL VIOLATIONS

In 2015, there were 10,261 violations of the Total Coliform rule by 5,233 community water systems across the country. The systems in violation served 17,768,807 people. Nationwide, the states or territories with the largest populations served by systems with violations were:

- Texas (4,435,648 people served)
- Florida (1,879,621 people served)
- Puerto Rico (1,363,753 people served)
- New Jersey (1,202,586 people served)
- Kentucky (827,252 people served)

When ranked by percentage of population served by community water systems with violations of the Total Coliform Rule, Puerto Rico ranked highest, with 39.3 percent of the population served by violating systems.[a]

HEALTH-BASED VIOLATIONS

In 2015, there were 2,574 health-based violations of the Total Coliform Rule by 1,909 community water systems across the country. The systems in violation served 10,118,586 people. Nationally, these states and territories had the largest populations served by violating systems:

- Texas (3,132,827 people served)
- Puerto Rico (1,315,751 people served)
- Florida (816,298 people served)
- Louisiana (550,645 people served)
- New Jersey (462,968 people served)

Of the states/territories with health-based violations to the Total Coliform Rule, Puerto Rico had the highest percentage of its population (37.9 percent) served by violating systems.[b]

ENFORCEMENT

Of the 10,261 reported violations of the Total Coliform Rule in 2015, formal enforcement action was taken by EPA or the states in only 8.8 percent of cases.[c] A little less than half (4,164 violations) returned to compliance within the calendar year.

For health-based violations of the Total Coliform Rule, formal enforcement action was taken by EPA or the states in 8.3 percent of the 2,574 violations reported in 2015.[d] Less than 50 percent of the health-based violations (47.9 percent; 1,233 violations) returned to compliance within the calendar year.

a In 2015, the estimated population of Puerto Rico was 3,474,182 people (from the Annual Estimates of the Resident Population for the United States, Regions, States, and Puerto Rico: April 1, 2010, to July 1, 2015 (NST-EST2015-01); U.S. Census Bureau, Population Division).

b In 2015, the estimated population of Puerto Rico was 3,474,182 people (from the Annual Estimates of the Resident Population for the United States, Regions, States, and Puerto Rico: April 1, 2010, to July 1, 2015 (NST-EST2015-01); U.S. Census Bureau, Population Division).

c Formal enforcement action was taken for 902 violations out of the total 10,261 violations of the Total Coliform Rule in calendar year 2015. The federal government was responsible for 0.4 percent of formal enforcement actions (4 violations), and states were responsible for 99.6 percent (898 violations) of formal enforcement actions. Any enforcement action (including formal and informal actions) was taken in 85.6 percent (8,787 actions for 10,261 violations) of cases.

d Formal enforcement action was taken for 214 of the health-based violations of the Total Coliform Rule in calendar year 2015. The federal government was responsible for 0.5 percent of formal enforcement actions (1 violation), and states were responsible for 99.5 percent (213 violations) of formal enforcement actions. Any enforcement action (including formal and informal actions) was taken in 95.4 percent (2,455 violations) of cases.

FIGURE 2.1: 17.8 MILLION PEOPLE SERVED BY COMMUNITY WATER SYSTEMS WITH AT LEAST ONE REPORTED VIOLATION OF THE TOTAL COLIFORM RULE (2015). POPULATIONS ARE SHADED AT THE COUNTY LEVEL TO SHOW NUMBER OF RESIDENTS SERVED BY COMMUNITY WATER SYSTEMS WITH VIOLATION(S) IN 2015.

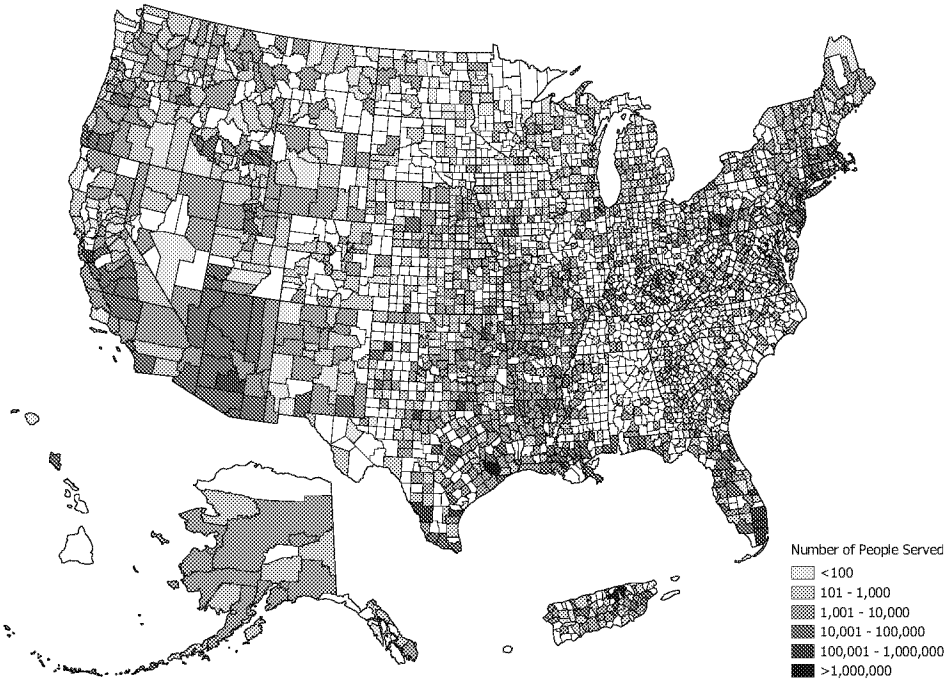
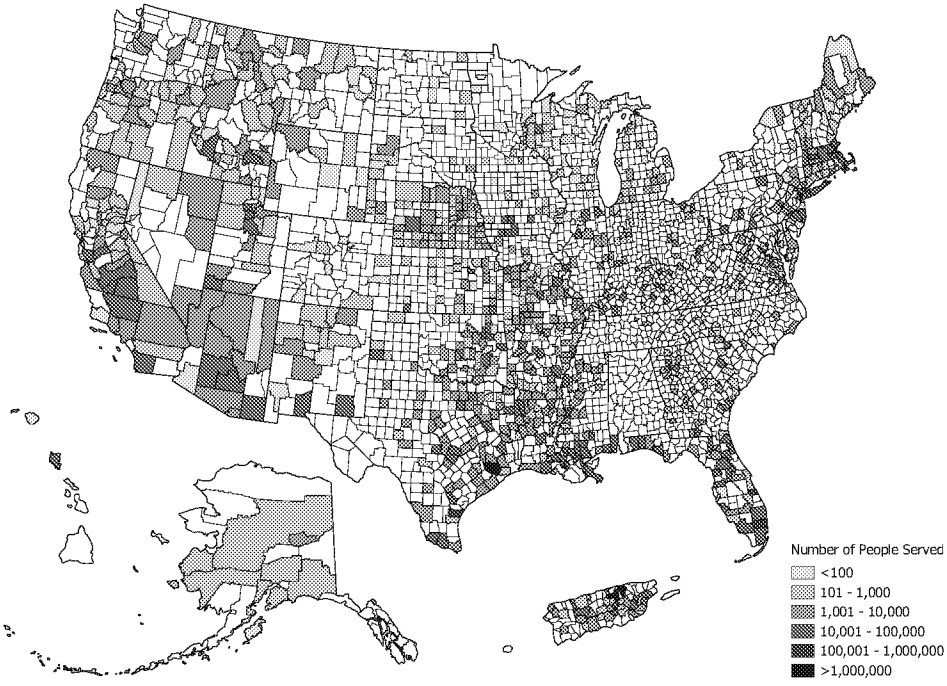


FIGURE 2.2: 10.1 MILLION PEOPLE SERVED BY COMMUNITY WATER SYSTEMS WITH AT LEAST ONE REPORTED HEALTH-BASED VIOLATION OF THE TOTAL COLIFORM RULE (2015). POPULATIONS ARE SHADED AT THE COUNTY LEVEL TO SHOW NUMBER OF RESIDENTS SERVED BY COMMUNITY WATER SYSTEMS WITH VIOLATION(S) IN 2015.



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Appendix 3: Surface Water Treatment Rules and Ground Water Rule

- The Surface Water Treatment Rules and Ground Water Rule establish requirements to protect people who drink the water from treatment plants from getting ill from pathogens that could be in the water. Some of these pathogens, such as *Cryptosporidium* or *Giardia*, can cause severe gastrointestinal distress, nausea, and diarrhea, and in the very young, elderly, and immune-compromised people they can cause serious, life-threatening infections.
- In 2015 there were 5,979 violations (1,790 of them health-based) at community water systems serving 17,312,604 people (5,336,435 health-based).
- Formal enforcement was taken in 13.7 percent of cases (28.2 percent of health-based cases).
- A little less than one-third of the violations (and a little less than one-fourth of the health-based violations) returned to compliance within the calendar year.

BACKGROUND

Drinking water comes from either surface water or ground water sources.[1] Surface water includes streams, lakes, wetlands, bays, and oceans.[2] Groundwater, on the other hand, is found below the surface in aquifers and is brought to the surface by wells. The distinction between the two types of source water is not always clear, as ground water sources may be influenced by surface water. For instance, if a well is situated near a major lake, that lake water can essentially be sucked into the well as it is pumped.[3] Both types of water sources can be susceptible to contamination by microorganisms, including parasites, viruses, and bacteria.[4]

In most surface water systems, after dirt and other large particles are removed from the source water, the water is commonly filtered through a material like sand, gravel, or charcoal to remove small particles like bacteria, viruses, parasites, and chemicals.[5] After filtration, disinfectants are added. (See chapter on Disinfection Byproducts Rules.) Most public water systems using surface waters like lakes or rivers are required to filter their water; however, a relatively small number of surface water systems that meet heightened watershed and source water protection criteria are allowed to only disinfect their water without filtration.[6]

Pathogens such as viruses, *Giardia*, *Cryptosporidium*, and *Legionella* can be found in sources of drinking water that have been contaminated, often by animal fecal waste.[7] EPA established the Surface Water Treatment Rules and Ground Water Rule to protect against these pathogens and to reduce the incidence of illness associated with harmful microorganisms in drinking water.

HEALTH EFFECTS

According to the U.S. Environmental Protection Agency (EPA), "Fecal contamination of drinking water is a primary source of waterborne disease."[8] Health symptoms related to drinking or swallowing water with fecal contamination include diarrhea, cramps, nausea, headaches, and other symptoms. Pathogens present in contaminated water may pose a special health risk for infants, young children, the elderly, and people with severely compromised immune systems.

Cryptosporidium is a parasite commonly found in surface water that is used as a source of drinking water.[9] It has been the cause of many waterborne disease outbreaks in the United States, including the tragic Milwaukee outbreak in 1993 that sickened more than 400,000 people and killed at least 69.[10,11] *Cryptosporidium* can cause gastrointestinal illness that can be fatal for people with comprised immune systems.

Giardia is another parasite commonly found in surface drinking water.[12] *Giardia* causes infection in humans by attaching to the wall of the small intestine in the upper gastrointestinal tract.[13] Giardiasis can manifest as an asymptomatic infection, acute diarrhea, or chronic diarrhea.[14] People with giardiasis may also experience steatorrhea (excessive fat in the stool), abdominal cramps, bloating, flatulence, weight loss, and vomiting. Malabsorption of fats or fat-soluble vitamins can occur. In some patients, symptoms of giardiasis may persist for only three or four days, but others experience symptoms for several months. Chronic giardiasis, while infrequent, may persist for years.[15]

Legionella are small, rod-shaped bacteria most commonly found in water, including ground water, fresh and marine surface waters, and potable (treated) waters.[16] *Legionella* bacteria can cause Pontiac fever and Legionnaires' disease. Pontiac fever is an acute illness with flu-like symptoms including fever, chills, headache, myalgia (muscle pain), and malaise.[17] Legionnaire's disease is potentially fatal. Typically, malaise, myalgia, anorexia, headache, and fever occur within 48 hours in a person suffering from Legionnaire's disease. Other common early features of the illness include a dry cough, neurological abnormalities such as confusion and disorientation, lethargy, and gastrointestinal symptoms like nausea, vomiting, and diarrhea.[18] Chest pain, dyspnea, and respiratory distress may also present as the disease progresses. Extrapulmonary diseases stemming from *Legionella* infection are rare but can occur.[19]

It is worth noting that a significant outbreak of Legionnaire's disease that sickened dozens of local residents and killed several was observed in and around Flint, Michigan, after the city switched its water source and was having problems with its water treatment.[20] Although state health department experts, EPA staff, and others expressed concern about this outbreak's possible link to the city's tap water, no link to the water was ever conclusively established.[21] Recently a senior state health department expert pled "no contest" to criminal charges; according to her plea, she had reported to her superior that an outbreak of Legionnaires' disease in Genesee County in 2014 and 2015 "was related to the switch in the water source from the Detroit Water and Sewerage Department to the Flint River" but failed to report the problem to others.[22] The independent task force investigating the Flint crisis found "the pattern of an abrupt increase in cases of Legionellosis in Genesee County in 2014–15 that occurred after a shift to the Flint River strongly implicates the water source and treatment of the water as a potential cause of higher Legionellosis case incidence."[23]

SURFACE WATER TREATMENT RULES

The Surface Water Treatment Rules apply to public water systems using surface water sources, and to groundwater sources under the direct influence of surface water.[24] The purpose of the rules is to protect the public against the adverse health effects of exposure to pathogens.

The Surface Water Treatment Rules consist of a series of regulations that the EPA promulgated between 1989 and 2006.[25] The agency issued the Surface Water Treatment Rule in 1989, the Filter Backwash Recycling Rule in 2001, the Long Term 1 Enhanced Surface Water Treatment Rule in 2002, and the Long Term 2 Enhanced Surface Water Treatment Rule in 2006.[26]

Surface Water Treatment Rule—June 1989[27]

The Surface Water Treatment Rule for the most part requires that drinking water taken from surface waters like lakes or streams be treated by disinfection and, in most cases, filtration. The rule requires systems using surface water or ground water under the influence of surface water to filter and disinfect water; creates maximum contaminant level goals (MCLGs) of zero for viruses, Legionella, and *Giardia lamblia*; and sets treatment technique requirements for filtered and unfiltered systems to reduce exposure to pathogens, including watershed protection and water quality requirements for systems that do not filter their treated water.

Interim Enhanced Surface Water Treatment Rule[28]

This rule applies to public water systems serving at least 10,000 people and using either surface water or groundwater under the influence of surface water. It sets an MCLG of zero for *Cryptosporidium*, requires 99 percent removal (called 2-log) of *Cryptosporidium*, mandates covers on all new finished water storage facilities, and requires that sanitary surveys be conducted for all water systems, regardless of size. Sanitary surveys consist of "an onsite review of the water source, facilities, equipment, operation, and maintenance of a public water system for the purpose of evaluating the adequacy of such source, facilities, equipment, operation, and maintenance for producing and distributing safe drinking water."[29] The rule further mandates that watershed protection programs address *Cryptosporidium* where systems are not required to provide filtration, and requires that systems calculate levels of microbial inactivation.

Filter Backwash Recycling Rule—June 2001[30]

As water treatment plants filter their water, the filters collect particles and trap bacteria and other pathogens. The filters need to be cleaned regularly, and they are cleaned by forcing water back through the filter. That dirty water, called backwash, is then recycled through the treatment process again—meaning that the potentially contaminated gunk that has accumulated on the filter is often flushed right back into the water treatment plant, where it is mixed with the incoming water from the lake or river source that the system uses. Because of the potential risks from this practice, the Filter Backwash Rule requires public water systems to review their backwash water recycling practices to address any possible compromise of microbial control. It mandates that filter backwash water go through all processes of a system's conventional or direct filtration treatment.

Long Term 1 Enhanced Surface Water Treatment Rule—January 2002[31]

This rule expands the requirements of the interim rule to include public water systems using surface water that serve fewer than 10,000 people.

Long Term 2 Enhanced Surface Water Treatment Rule—January 2006[32]

This rule targets systems that have higher potential for contamination by *Cryptosporidium*. It relies on treatment technique (rather than MCL) requirements to reduce adverse health impacts. The rule requires additional *Cryptosporidium* treatment in systems with a high risk of contamination, such as those that do not filter their treated drinking water. It also addresses risks to uncovered finished water storage facilities posed by runoff, animal waste, and human activity, among other potential threats. In particular, those systems either have to achieve certain inactivation levels for *Cryptosporidium*, as well as *Giardia lamblia* and viruses, or must cover their storage facilities. Finally, the rule requires systems to maintain microbial protection while taking steps to reduce disinfection byproduct contamination. The rule requires surface water systems or systems using ground water under the influence of surface water to monitor and determine an average level of *Cryptosporidium*. That level determines the extent of the treatment that the system is required to undertake. All unfiltered systems are required to inactivate 99 percent of the *Cryptosporidium* level and to do so using at least two disinfectants.

GROUND WATER RULE

Most groundwater systems are small.[33] Prior to issuing the Ground Water Rule, the EPA estimated that approximately 20 million people receive water that has not been disinfected, and that 70 million people receive water that either is not disinfected or has not been treated to remove 99.9 percent of viruses.[34]

Ground Water Rule—2006[35]

The Ground Water Rule applies to public water systems using ground water as a source of drinking water. It uses a risk-based strategy to target ground water systems vulnerable to fecal contamination, rather than requiring all ground water systems to disinfect.[36] Most of the outbreaks in ground water systems result either from contamination of the source water or from inadequate treatment.[37] Under the Ground Water Rule, ground water systems at risk of fecal contamination must take corrective action. The rule requires routine sanitary surveys of systems, including evaluation of eight critical elements of a public water system to identify significant deficiencies in those systems. It also mandates triggered source monitoring for high-risk systems that identify positive samples during regular surface and ground water treatment monitoring or assessment monitoring. It further requires corrective action for systems with significant deficiencies or source water fecal contamination, and compliance monitoring to ensure that treatment technology reliably achieves 99.9 percent inactivation or removal of viruses in drinking water.

The rule requires that systems with evidence of fecal contamination or with a significant deficiency (as identified by the sanitary survey) must take one of the following corrective actions: "Correct all significant deficiencies; provide an alternate source of water; eliminate the source of contamination; or provide treatment that reliably achieves at least 99.99 percent (4-log) treatment of viruses (using inactivation, removal, or a State-approved combination of 4-log virus inactivation and removal) for each ground water source."[38]

ALL VIOLATIONS

In 2015, there were 5,979 violations of the combined surface and ground water treatment rules by 2,697 community water systems across the country. The systems in violation served 17,312,604 people (see Table 3.1 for populations served, number of violations, and number of systems in violation for the individual surface and ground water treatment rules).

Nationwide, these states and territories had the largest populations served by violating systems:

- New Jersey (2,602,285 people served)
- Pennsylvania (2,352,580 people served)
- Florida (1,832,411 people served)
- Puerto Rico (1,713,320 people served)
- Texas (1,441,484 people served)

When ranked by percentage of population served by community water systems with violations of the various surface and ground water treatment rules, Puerto Rico ranked the highest, with 49.3 percent of the population served by violating systems.[a]

a In 2015, the estimated population of Puerto Rico was 3,474,182 people (from the Annual Estimates of the Resident Population for the United States, Regions, States, and Puerto Rico: April 1, 2010 to July 1, 2015 (NST-EST2015-01); U.S. Census Bureau, Population Division).

HEALTH-BASED VIOLATIONS

In 2015, there were 1,790 health-based violations of the various surface and ground water treatment rules by 813 community water systems across the country. The systems in violation served 5,336,435 people.

Nationally, these states and territories had the largest populations served by violating systems:

- Puerto Rico (1,229,785 people served)
- Washington (922,345 people served)
- California (562,609 people served)
- Ohio (417,253 people served)
- New York (378,642 people served)

Of the states/territories with health-based violations to the combined surface and ground water treatment rules, Puerto Rico had the highest percentage of its population (35.4 percent) served by violating systems.[b]

ENFORCEMENT

Of the 5,979 reported violations of the various surface and ground water treatment rules in 2015, formal enforcement action was taken by the EPA or the states in only 13.7 percent of cases.[c] A little less than one-third (1,864 violations) returned to compliance within the calendar year.

For health-based violations of the various surface and ground water treatment rules, formal enforcement action was taken by the EPA or the states in 28.2 percent of the 1,790 cases in 2015.[d] A little less than one-fourth of the health-based violations (24.6 percent; 440 violations) returned to compliance within the calendar year.

TABLE 3.1 VIOLATIONS OF VARIOUS SURFACE AND GROUND WATER TREATMENT RULES IN 2015, RANKED BY POPULATION SERVED[e]

RULE	POPULATION SERVED	NUMBER OF VIOLATIONS	NUMBER OF SYSTEMS
Ground Water Rule	5,845,055	3,295	1,933
Surface Water Treatment Rule	5,707,305	1,486	564
Long Term 1 Enhanced Surface Water Treawment Rule	5,227,488	1,038	322
Long Term 2 Enhanced Surface Water Treatment Rule	3,955,408	159	64
Filter Backwash Rule	14,728	1	1
Total[f]	17,312,604	5,979	2,697
HEALTH-BASED VIOLATIONS ONLY			
Surface Water Treatment Rule	2,691,720	653	290
Long Term 1 Enhanced Surface Water Treatment Rule	2,019,672	285	126
Ground Water Rule	437,495	765	379
Long Term 2 Enhanced Surface Water Treatment Rule	243,591	87	34
Filter Backwash Rule	0	0	0
Total[g]	5,336,435	1,790	813

b In 2015, the estimated population of Puerto Rico was 3,474,182 people (from the Annual Estimates of the Resident Population for the United States, Regions, States, and Puerto Rico: April 1, 2010, to July 1, 2015 (NST-EST2015-01), U.S. Census Bureau, Population Division).

c Formal enforcement action was taken for 822 violations out of the total 5,979 violations of the various surface and ground water treatment rules in calendar year 2015. The federal government was responsible for 25.3 percent of formal enforcement actions (208 violations), and states were responsible for 74.7 percent (614 violations) of formal enforcement actions. Any enforcement action (including formal and informal actions) was taken in 90.5 percent of cases (5,413 actions for 5,979 violations).

d Formal enforcement action was taken for 505 of the 1,790 health-based violations of the various surface and ground water treatment rules in 2015. The federal government was responsible for 39.8 percent of formal enforcement actions (201 violations) and states were responsible for 60.2 percent (304 violations) of formal enforcement actions. Any enforcement action (including formal and informal actions) was taken in 89.5 percent of cases (1,603 violations).

e Data are from the 2016 quarter 3 data set of the Safe Drinking Water Information System.

f Populations served by systems with violations of more than one ground or surface water rule were counted only once, resulting in a smaller total population served for the combined rules than for the rules tallied individually.

g Populations served by systems with violations to more than one ground or surface water rule were counted only once, resulting in a smaller total population served for the combined rules than for the rules tallied individually.

FIGURE 3.1: 17.3 MILLION PEOPLE SERVED BY COMMUNITY WATER SYSTEMS WITH AT LEAST ONE REPORTED VIOLATION OF THE SURFACE AND GROUND WATER TREATMENT RULES (2015). POPULATIONS ARE SHADED AT THE COUNTY LEVEL TO SHOW THE NUMBER OF RESIDENTS SERVED BY COMMUNITY WATER SYSTEMS WITH VIOLATION(S) IN 2015.

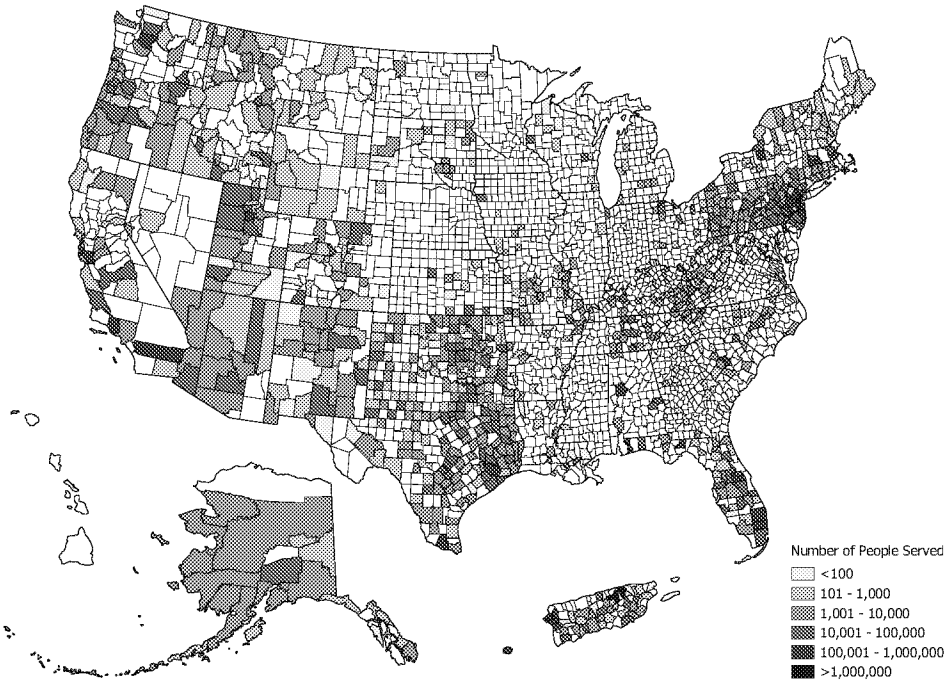
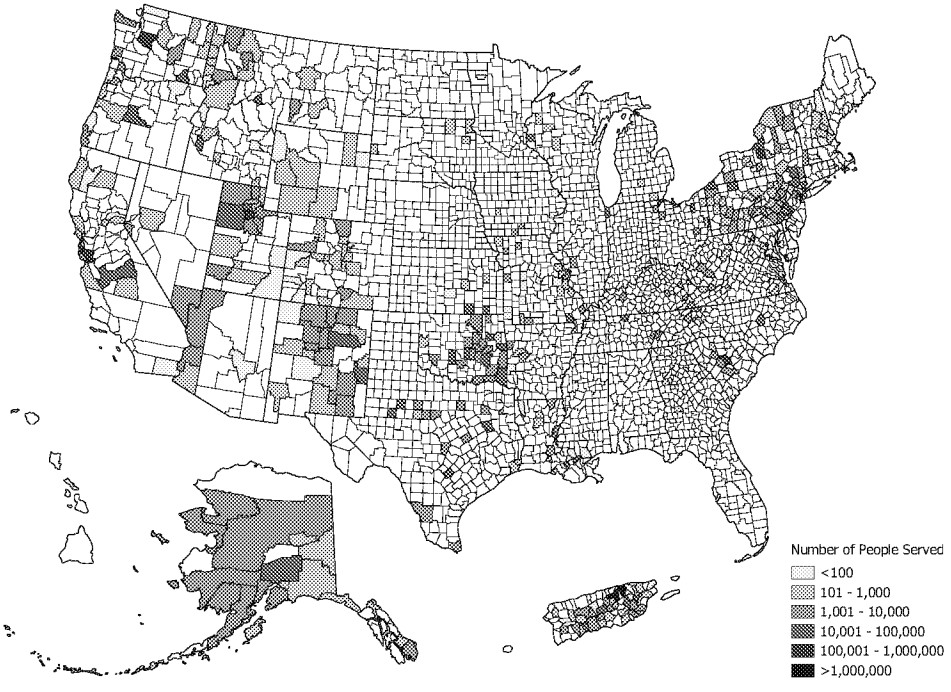


FIGURE 3.2: 5.3 MILLION PEOPLE SERVED BY COMMUNITY WATER SYSTEMS WITH AT LEAST ONE REPORTED HEALTH-BASED VIOLATION OF THE SURFACE AND GROUND WATER TREATMENT RULES (2015). POPULATIONS ARE SHADED AT THE COUNTY LEVEL TO SHOW THE NUMBER OF RESIDENTS SERVED BY COMMUNITY WATER SYSTEMS WITH VIOLATION(S) IN 2015.



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1 U.S. Environmental Protection Agency (hereinafter EPA), "Basic Information About Your Drinking Water," https://www.epa.gov/ground-water-and-drinking-water/basic-information-about-your-drinking-water.

2 *See* 40 CFR 141.2. ("*Surface water* means all water which is open to the atmosphere and subject to surface runoff.")

3 Ibid. ("*Ground water under the direct influence of surface water* (GWUDI) means any water beneath the surface of the ground with significant occurrence of insects or other macroorganisms, algae, or large-diameter pathogens such as *Giardia lamblia* or *Cryptosporidium*, or significant and relatively rapid shifts in water characteristics such as turbidity, temperature, conductivity, or pH which closely correlate to climatological or surface water conditions.")

4 Ibid. EPA, "Surface Water Treatment Rules," https://www.epa.gov/dwreginfo/surface-water-treatment-rules. EPA, "Ground Water Rule," https://www.google.com/webhp?sourceid=chrome-instant&ion=1&espv=2&ie=UTF-8#q=epa%20ground water%20rule.

5 Centers for Disease Control and Prevention, "Community Water Treatment," http://www.cdc.gov/healthywater/drinking/public/water_treatment.html.

6 Ibid.

7 EPA, "Surface Water Treatment Rules." EPA, "Ground Water Rule."

8 EPA, "What Indicators Does EPA Regulate in Drinking Water, and How Do They Reflect Problems?" https://safewater.zendesk.com/hc/en-us/articles/211400618-04-What-indicators-does-EPA-regulate-in-drinking-water-and-how-do-they-reflect-problems-Viruses-

9 Mac Kenzie, W.R., et al., "A Massive Outbreak in Milwaukee of Cryptosporidium Infection Transmitted Through the Public Water Supply," *N Engl J Med*. 331, no. 3 (July 21, 1994):161–7, https://www.gpo.gov/fdsys/pkg/FR-2006-01-05/pdf/06-4.pdf.

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12 EPA, *Giardia: Drinking Water Fact Sheet*, September 2000, https://www.epa.gov/sites/production/files/2015-10/documents/giardia-factsheet.pdf.

13 Ibid.

14 Ibid.

15 Ibid.

16 EPA, *Legionella: Drinking Water Fact Sheet*, September 2000, https://www.epa.gov/sites/production/files/2015-10/documents/legionella-factsheet.pdf.

17 EPA, *Legionella: Drinking Water Advisory*, March 2001, https://www.epa.gov/sites/production/files/2015-10/documents/legionella-report.pdf.

18 Ibid.

19 Ibid.

20 *See, for example,*Flint Water Advisory Task Force, Letter to Governor Snyder, December 29, 2015, flintwaterstudy.org/wp-content/uploads/2015/12/FWATF-SnyderLetter-12-29-15.pdf,;] *See also:* Ridley, G., "Eighth Case of Legionnaire's Disease Reported in Genesee County," *Detroit Free Press*, September 16, 2016, http://www.mlive.com/news/flint/index.ssf/2016/09/eighth_case_of_legionnaires_di.html.

21 Ibid.

22 Ridley, G., "Eighth Case of Legionnaire's Disease Reported."

23 Flint Water Advisory Task Force, at 25.

24 40 CFR 141.70. 40 CFR 141.75. 40 CFR 141.170-141.175. 40 CFR 141.76. 40 CFR 141.500-141.571. EPA, "Surface Water Treatment Rules

25 Ibid.

26 Ibid.

27 40 CFR 141.70-141.75

28 40 CFR 141.170-141.175

29 Ibid.

30 40 CFR 141.76(a)

31 40 CFR 141.500-141.571

32 40 CFR 141.700-141.722

33 EPA, "Regulatory Impact Analysis for the Proposed Ground Water Rule," 2000, at page 4-3, Exhibit 4-1, https://www.epa.gov/sites/production/files/2015-10/documents/regulatory_impact_analysis_for_the_proposed_ground_water_rule.pdf.

34 Ibid. *See also:* "Ground Water Rule," 71 Fed. Reg. 65574, November 8, 2006.

35 "Ground Water Rule," 71 Fed. Reg. 65574, November 8, 2006; Correction 71 Fed. Reg. 67427, November 21, 2006; primarily codified at 40 CFR 141.400 et seq.

36 "Ground Water Rule," 71 Fed. Reg. 65574.

37 Ibid.

38 40 CFR 141.403(a)(6).

Appendix 4: Nitrates and Nitrites

- Exposure to nitrates and nitrites can lead to blue baby syndrome in infants, developmental effects, and cardiovascular disease. In extreme cases, blue baby syndrome can be severe and lead to death.
- In 2015, there were 1,529 violations (459 of them health-based) at community water systems serving 3,867,431 people (1,364,494 health-based).
- Formal enforcement action was taken in 11.3 percent of all cases (and 27.9 percent of health-based cases).
- Less than half of the violations (and about one-sixth of health-based violations) returned to compliance within the calendar year.

BACKGROUND

Nitrates and nitrites are nitrogen–oxygen chemical units that have combined with different organic and inorganic compounds.[1] They occur naturally in water, soil, plants, and food.[2] Nitrates and nitrites are more commonly found in groundwater than in surface water and are more commonly detected in well water.[3] Nitrates convert into nitrites when ingested into the body.[4]

Nitrates can enter drinking water from a number of sources, including runoff or seepage from fertilized agricultural lands; from municipal or industrial wastewater; and from refuse dumps, animal feedlots, septic tanks, livestock manure, and erosion of plant debris.[5] Nitrates in the form of potassium nitrate and ammonium nitrate, which are widely used as fertilizers, are a widespread cause of water contamination.[6] Because nitrates are very soluble and do not bind to soil, they often migrate to ground water.[7] Nitrate contamination more commonly impacts wells that are close to sources of nitrates, and wells that are shallow or in areas with large numbers of aging septic tanks or concentrated animal feeding operations.[8] Because nitrates do not evaporate, they are likely to remain in water until they are consumed by plants or other organisms.[9]

Nitrites possess physical properties similar to those of nitrates and are associated with nitrates and their sources. Nitrites are typically absent in groundwater, or present to a much lesser extent, because it they are rapidly converted to nitrates.

HEALTH EFFECTS OF NITRATES AND NITRITES

When the body reduces ingested nitrates to nitrites, the resulting condition can cause a temporary blood disorder in infants called methemoglobinemia, or blue baby syndrome.[10] Nitrites absorbed through the stomach react with hemoglobin to form methemoglobin, which cannot carry oxygen with the same capacity as hemoglobin. This impairs the body's ability to carry oxygen to body tissues, resulting in an oxygen deficiency in the infant's blood.[11] This acute condition usually occurs in infants less than six months old, developing rapidly over a period of days.[12] Symptoms include shortness of breath and blueness of skin, especially around the eyes and mouth.[13] When the nitrate-contaminating source is removed from the body, the effects may be reversible. Blue baby syndrome may lead to coma and eventual death.[14]

While methemoglobinemia is rare in adults, pregnant women are particularly susceptible to the condition, since it is common for methemoglobin levels to increase during pregnancy.[15] It is therefore especially important that pregnant women be sure that the nitrate concentrations in their drinking water are at safe levels. People with medical conditions such as reduced stomach acidity may also be more vulnerable to the harmful effects of methemoglobinemia, such as abdominal cramps and vomiting.[16]

Long-term exposure to nitrates and nitrates at levels above the maximum contaminant level (MCL) may also have effects on thyroid function and development as well as on cardiovascular health.[17,18] The International Agency for Research on Cancer, a research arm of the World Health Organization, also has classified nitrates and nitrites as probable carcinogens in certain circumstances.[19]

EPA REGULATION OF NITRATES AND NITRITES

In 1992, the U.S. Environmental Protection Agency (EPA) set the maximum contaminant level goal (MCLG) and MCL for nitrates at 10 parts per million (ppm) and for nitrites at 1 ppm.[20] The EPA reviewed nitrates and nitrites as part of a required Six Year Review and retained those standards as still protective of human health.[21]

Nitrates and nitrites have different sampling requirements. All public water systems are required to monitor for the presence of nitrates.[22] Both ground and surface water community water systems must conduct monitoring annually. Increased monitoring is required where results detect nitrate levels greater than the MCL for ground water systems, and greater than one half of the MCL for surface water systems, for at least four consecutive quarters until the state determines that that the system reliably and consistently meets the detection limit.[23] Some states require surface water systems to monitor monthly because they are more vulnerable to contamination from agricultural runoff.[24]

Public water systems must also monitor for the presence of nitrites. Under EPA regulations, if any system meets or exceeds the trigger level (one-half the MCL) for nitrite at any time, the system must conduct quarterly sampling beginning in the next quarter.[25] The state may allow a system to reduce the quarterly sampling to annual sampling provided four quarterly results are reliably and consistently below the MCL.[26]

ALL VIOLATIONS

In 2015, there were 1,529 violations of nitrate and nitrite standards by 971 community water systems across the country. The systems in violation served 3,867,431 people.

Nationwide, these states had the largest populations served by violating systems:

- Ohio (1,159,887 people served)
- Texas (908,380 people served)
- Connecticut (459,690 people served)
- Florida (238,182 people served)
- New Jersey (188,529 people served)

When ranked by percentage of population served by community water systems with violations of nitrate and nitrite standards, Connecticut ranked the highest, with 12.8 percent of its population served by violating systems.[a]

HEALTH-BASED VIOLATIONS

In 2015, there were 459 health-based violations of nitrate and nitrite standards by 192 community water systems across the country. The systems in violation served 1,364,494 people.

Nationally, these states had the largest populations served by violating systems:

- Ohio (1,159,887 people served)
- Iowa (72,734 people served)
- Texas (28,644 people served)
- Wisconsin (25,005 people served)
- Nebraska (18,079 people served)

Of the states/territories with health-based violations of nitrate and nitrite standards, Ohio had the highest percentage of its population (10.0 percent) served by violating systems.[b]

ENFORCEMENT

Of the 1,529 reported violations of nitrate and nitrite standards in 2015, formal enforcement action was taken by the EPA or the states in only 11.3 percent of cases.[c] Less one out of every seven violations (207 violations) returned to compliance within the calendar year.

For health-based violations of nitrate and nitrite standards, formal enforcement action was taken by the EPA or the states in 27.9 percent of the 459 cases reported in 2015.[d] Less than one-tenth of the health-based violations (9 percent; 42 violations) returned to compliance within the calendar year.

a In 2015, the estimated population of Connecticut was 3,590,886 people (from the Annual Estimates of the Resident Population for the United States, Regions, States, and Puerto Rico: April 1, 2010, to July 1, 2015 (NST-EST2015-01), U.S. Census Bureau, Population Division).

b In 2015, the estimated population of Ohio was 11,613,423 people (from the Annual Estimates of the Resident Population for the United States, Regions, States, and Puerto Rico: April 1, 2010, to July 1, 2015 (NST-EST2015-01), U.S. Census Bureau, Population Division).

c Formal enforcement action was taken for 173 violations out of the total 1,529 violations of the nitrate and nitrite standards in calendar year 2015. The federal government was responsible for 2.9 percent of formal enforcement actions (5 violations), and states were responsible for 97.1 percent (168 violations) of formal enforcement actions. Any enforcement action (including formal and informal actions) was taken in 91.0 percent of all cases (1,377 violations).

d Formal enforcement action was taken for 128 of the 459 health-based violations of nitrate and nitrite standards in 2015. The federal government was responsible for 3.9 percent of formal enforcement actions (5 violations), and states were responsible for 96.1 percent (123 violations). Any enforcement action (including formal and informal actions) was taken in 94.6 percent (434 violations) of cases.

FIGURE 4.1: 3.9 MILLION PEOPLE SERVED BY COMMUNITY WATER SYSTEMS WITH AT LEAST ONE REPORTED VIOLATION OF NITRATE AND NITRITE STANDARDS (2015). POPULATIONS ARE SHADED AT THE COUNTY LEVEL TO SHOW THE NUMBER OF RESIDENTS SERVED BY COMMUNITY WATER SYSTEMS WITH VIOLATION(S) IN 2015.

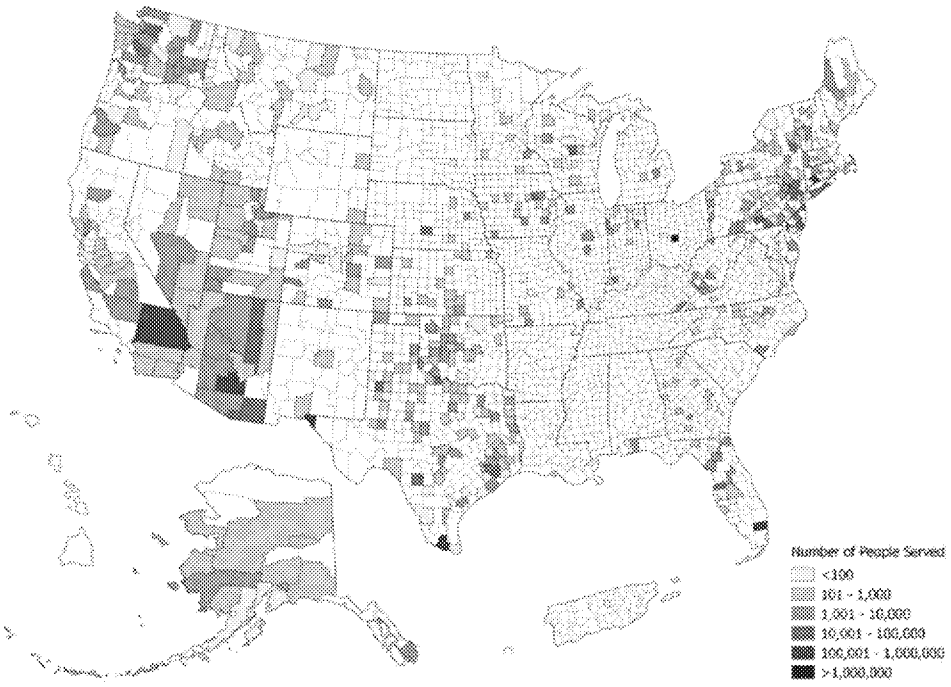
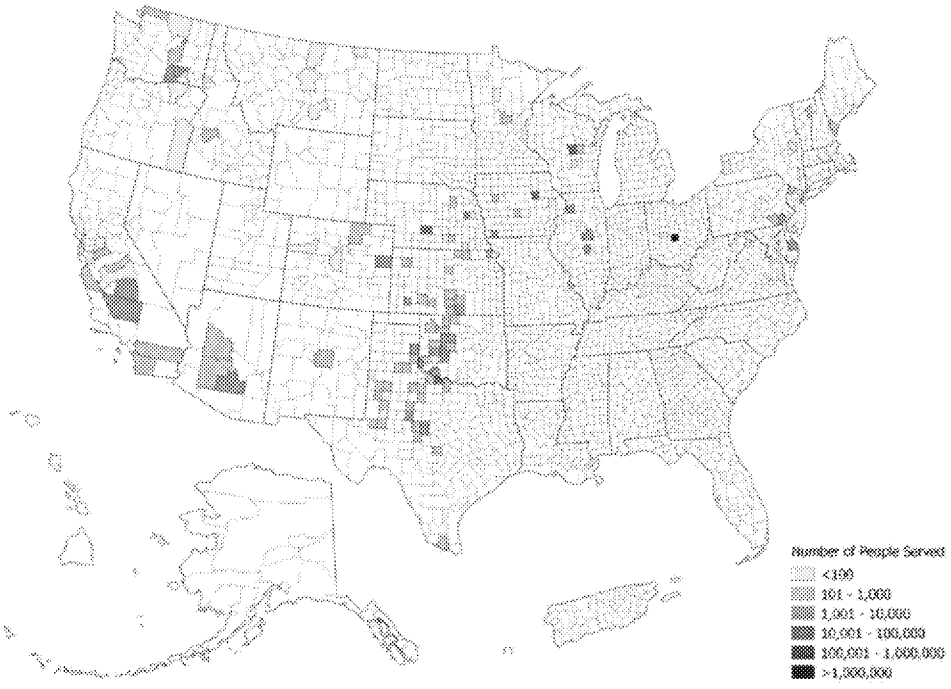


FIGURE 4.2: 1.4 MILLION PEOPLE SERVED BY COMMUNITY WATER SYSTEMS WITH AT LEAST ONE REPORTED HEALTH-BASED VIOLATION OF NITRATE AND NITRITE STANDARDS (2015). POPULATIONS ARE SHADED AT THE COUNTY LEVEL TO SHOW THE NUMBER OF RESIDENTS SERVED BY COMMUNITY WATER SYSTEMS WITH VIOLATION(S) IN 2015.



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1 U.S. Environmental Protection Agency (hereinafter EPA), "Chemical Contaminant Rules," https://www.epa.gov/dwreginfo/chemical-contaminant-rules.

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Appendix 5: Lead and Copper Rule

- Exposure to lead is particularly toxic to children and can cause serious, irreversible damage to their developing brains and nervous systems. Exposure can also cause miscarriages and stillbirths in pregnant women, as well as fertility issues, cardiovascular and kidney effects, cognitive dysfunction, and elevated blood pressure in healthy adults.
- In 2015, there were 8,044 violations by systems serving 18,350,633 people (including 303 health-based violations by systems serving 582,302 people).
- Formal enforcement action was taken in 12.0 percent of the cases (and in 14.2 percent of health-based cases).
- Nearly 1 in 20 violations (and less than 1 in 10 health-based violations) returned to compliance within the calendar year.

BACKGROUND

Lead pipes have been used for centuries to deliver water.[1] More recently, in the 1880s, cities around the United States began installing lead pipes on a large scale.[2] Lead pipes were often used because they are more malleable and can last longer than iron pipes.[3] Experts have estimated that 6 to 10 million lead service lines, which connect local water mains to individual residences, are being used in the United States, serving 15 to 22 million Americans.[4] Most were installed at least 50 years ago, though some were added more recently. Many plumbing fixtures inside the house also contain lead.[5] Because corrosive contaminants in water can cause lead to be released from pipes and fittings, national restrictions on lead pipes and lead-containing plumbing fixtures were introduced in 1986.[6,7] These restrictions were, however, fairly weak until a law allowing no more than 0.25 percent lead content went into effect in 2014.[8]

Copper can also enter drinking water through plumbing materials.[9] It is used in the manufacture of wire, plumbing pipes, and sheet metal and is also combined with other metals to make brass and bronze pipes and faucets.[10]

HEALTH EFFECTS OF LEAD AND COPPER

Exposure to lead can cause serious health problems, especially in children and pregnant women. There is no safe level of exposure to lead.[11] Even at low levels, exposure can cause serious, irreversible damage to the developing brains and nervous systems of babies and young children.[12] Lead exposure has been found to decrease children's cognitive capacity, cause behavior problems, and limit their ability to concentrate.[13] Scientific advisers at the World Health Organization and the Centers for Disease Control and Prevention have stated that some of these impacts on the cognitive capacity of a developing child can be irreversible, lasting into adulthood.[14] Lead can also cross the placental barrier of the womb in a pregnant woman and harm the fetus. Lead exposure can cause miscarriages, stillbirths, and infertility.[15] Exposure to lead can also cause adverse cardiovascular and kidney effects, cognitive dysfunction, and elevated blood pressure in otherwise healthy adults.[16] Exposure to copper can affect the digestive, hematological (blood forming), and liver systems.[17]

EPA REGULATION OF LEAD AND COPPER

The U.S. Environmental Protection Agency (EPA) has regulated lead in drinking water since it first issued interim standards under the Safe Drinking Water Act for about two dozen contaminants including lead in 1975.[18] In 1991, the EPA rescinded the 1975 interim maximum contaminant level for lead and replaced it with the Lead and Copper Rule, a complex treatment technique to control lead levels in tap water.[19] This rule is intended in part to address the release of lead from pipes and fittings from corrosive water, so it generally requires corrosion control.[20] Thus, under the Lead and Copper Rule, every water system serving more than 50,000 people must either treat its water to "optimize corrosion control" or demonstrate that it doesn't need to do so because its water isn't corrosive and there are no lead problems.[21]

The Lead and Copper Rule generally requires water systems to add a corrosion inhibitor (such as orthophosphate), which coats the inside of the pipes with a thin film that can reduce the amount of lead that leaches into the water.[22] The benefits of corrosion control to both private homeowners and public utilities exceed the treatment costs. Corrosion control reduces pipe breaks and leaks and makes pipes, water heaters, radiators, and plumbing components last longer. All water systems

are also required to test a specified number of drinking water taps in high-risk areas (i.e., in homes served by lead service lines or homes likely to have lead in their household plumbing or fixtures).[23] The bigger the system, the more taps that must be tested, with a maximum of 100 required in large cities.[24]

Under the Lead and Copper Rule, if more than 10 percent of the tested taps contain lead above the action level of 15 ppb, the water system must take measures to reduce lead levels.[25] These measures include better corrosion control and removal of lead service lines over a specified time period. The water system must conduct source water monitoring within 6 months and install source water treatment, and it must deliver public education within 60 days of the exceedance. Under the rule, the system must replace lead service lines if the lead action level is exceeded even after installing treatment.[26] For copper, if more than 10 percent of the tested taps contain copper above the action level of 1.3 ppm, the water system must begin corrosion control steps, conduct source water monitoring within 6 months, and install source water treatment.[27]

ALL VIOLATIONS

In 2015, there were 8,044 violations of the Lead and Copper Rule by 5,367 community water systems across the country. The systems in violation served 18,350,633 people.

Nationwide, the largest populations served by systems with violations to the Lead and Copper Rule were found in:

- Texas (6,910,988 people served)
- Puerto Rico (3,379,808 people served)
- Florida (1,753,865 people served)
- Georgia (1,378,155 people served)
- Massachusetts (1,117,415 people served)

When ranked by percentage of population served by community water systems with violations of the Lead and Copper Rule, Puerto Rico ranked the highest, with 97.2 percent of its population served by violating systems.[a]

HEALTH-BASED VIOLATIONS

In 2015, there were 303 health-based violations of the Lead and Copper Rule by 233 community water systems across the country. The systems in violation served 582,302 people.

Nationally, the states or territories with the largest populations served by violating systems were:

- Wisconsin (154,720 people served)
- Florida (117,139 people served)
- Texas (71,849 people served)
- North Carolina (65,928 people served)
- Illinois (57,338 people served)

Of the states/territories with violations to the Lead and Copper Rule, Wisconsin had the highest percentage of its population (2.7 percent) served by violating systems.[b]

ENFORCEMENT

Of the 8,044 reported violations of the Lead and Copper Rule in 2015, formal enforcement action was taken by the EPA or the states in only 12.0 percent of cases.[c] Only about 1 in 20 violations (6.2 percent; 501 violations) returned to compliance within the calendar year.

For health-based violations of the Lead and Copper Rule, formal enforcement action was taken by the EPA or the states for 14.2 percent of the 303 violations reported in 2015.[d] A little less than 1 in 12 of all health-based violations (8.6 percent; 26 violations) returned to compliance within the calendar year.

a In 2015, the estimated population of Puerto Rico was 3,474,182 people (from the Annual Estimates of the Resident Population for the United States, Regions, States, and Puerto Rico: April 1, 2010, to July 1, 2015 (NST-ST2015-01), U.S. Census Bureau, Population Division).

b In 2015, the estimated population of Wisconsin was 5,771,337 people (from the Annual Estimates of the Resident Population for the United States, Regions, States, and Puerto Rico: April 1, 2010, to July 1, 2015 (NST-EST2015-01), U.S. Census Bureau, Population Division).

c Formal enforcement action was taken for 963 violations out of the total 8,044 violations of the Lead and Copper Rule in calendar year 2015. The federal government was responsible for 7.1 percent of formal enforcement actions (68 violations), and states were responsible for 92.9 percent (895 violations). Any enforcement action (including formal and informal actions) was taken in 81.9 percent of cases (6,585 actions for 8,044 violations).

d Formal enforcement action was taken for 43 of the 303 health-based violations of the Lead and Copper Rule in 2015. The federal government was responsible for 16.3 percent of formal enforcement actions (7 violations, and states were responsible for 83.7 percent (36 violations). Any enforcement action (including formal and informal actions) was taken in 88.4 percent of cases (268 violations).

FIGURE 5.1: 18.4 MILLION PEOPLE SERVED BY COMMUNITY WATER SYSTEMS WITH AT LEAST ONE REPORTED VIOLATION OF THE LEAD AND COPPER RULE (2015). POPULATIONS ARE SHADED AT THE COUNTY LEVEL TO SHOW THE NUMBER OF RESIDENTS SERVED BY COMMUNITY WATER SYSTEMS WITH VIOLATION(S) IN 2015.

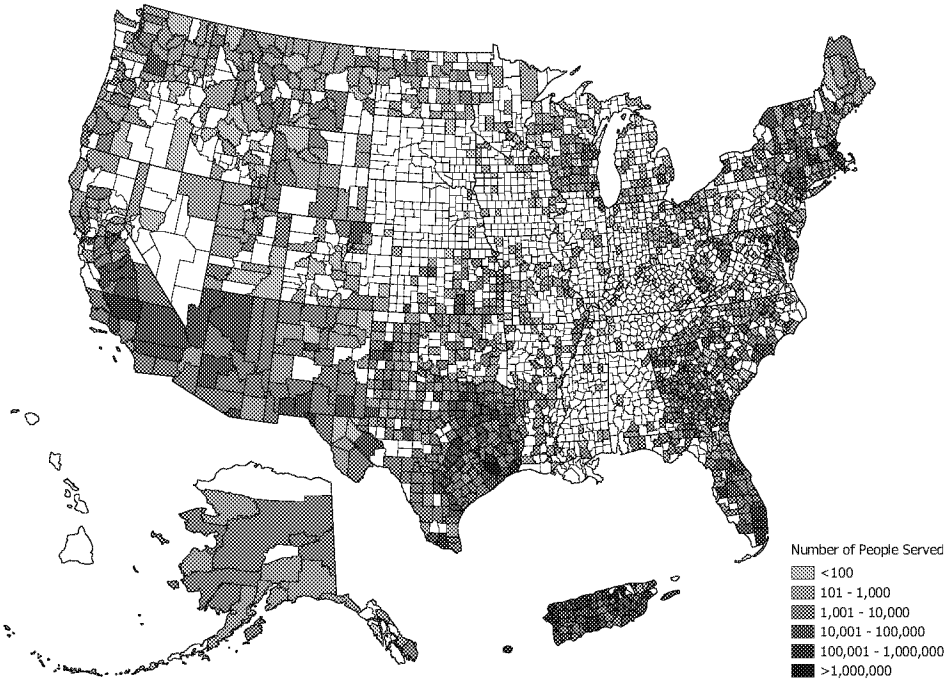
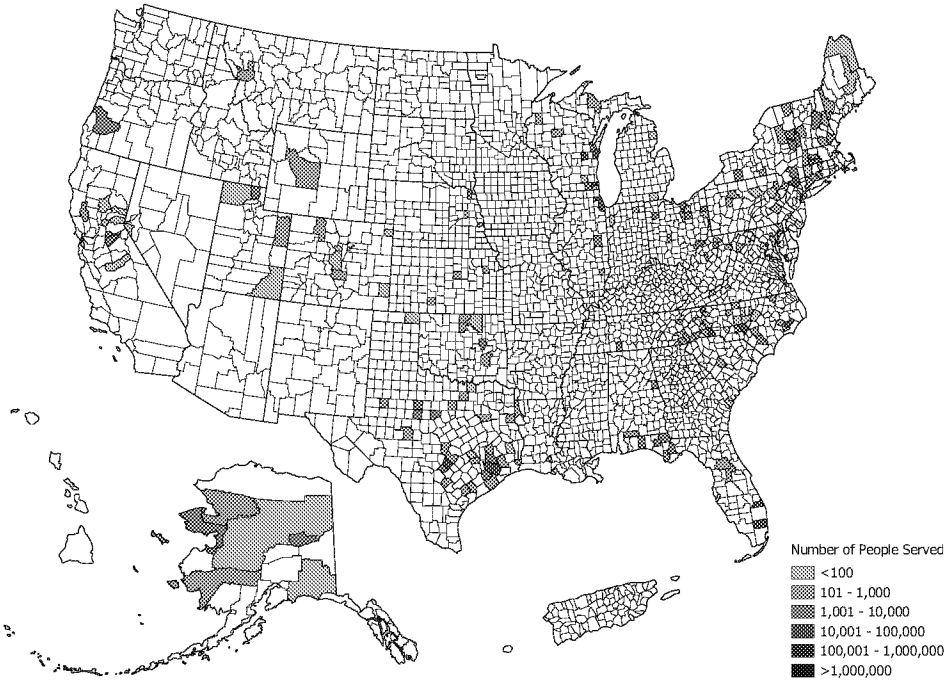


FIGURE 5.2: ALMOST 600,000 PEOPLE SERVED BY COMMUNITY WATER SYSTEMS WITH AT LEAST ONE REPORTED HEALTH-BASED VIOLATION OF THE LEAD AND COPPER RULE (2015). POPULATIONS ARE SHADED AT THE COUNTY LEVEL TO SHOW THE NUMBER OF RESIDENTS SERVED BY COMMUNITY WATER SYSTEMS WITH VIOLATION(S) IN 2015.



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Appendix 6: Radionuclides

- Exposure can lead to cancers and changes in kidney function.
- In 2015, there were 2,297 violations (962 of them health-based) in community water systems serving 1,471,364 people (445,969 health-based).
- Formal enforcement was taken in 11.7 percent of all cases (and 16.1 percent of health-based cases).
- About one in five violations (and about one in twenty health-based violations) returned to compliance within the calendar year.

BACKGROUND

Radionuclide refers to radioactive forms of elements.[1] Most radionuclides found in drinking water sources are naturally occurring radioactive particles found in the earth's crust and created in the upper atmosphere.[2] Many drinking water sources contain radionuclides at levels so low that they are not considered a big health concern[3] Of special concern, however, are naturally occurring uranium and the radioisotopes radium-226 and radium-228, which have been found at elevated levels in some drinking water sources.[4] Anthropogenic, or human-made, radionuclides are primarily beta and photon emitters, created through the production of electricity, nuclear weapons, nuclear medicines, and commercial products.[5] These radionuclides may be released into drinking water sources through improper waste storage, leaks, or transportation accidents.[6] Higher levels of radionuclides tend to be found in groundwater sources than in surface water sources.[7]

HEALTH EFFECTS OF RADIONUCLIDES

Radionuclides are known to cause cancer, and exposure to radionuclides in drinking water is reasonably anticipated to increase the risk of cancer in humans.[8] Radioactive particles emitted by radionuclides cause cellular damage in chromosomes and other parts of the cell as they travel through the body. This can result in uncontrolled cellular production, leading to cancer.[9] Radium, for example, accumulates in the bones, while iodine accumulates in the thyroid.[10] In addition to its carcinogenic affects, ingestion of elevated levels of uranium in drinking water can cause changes in kidney function that are indicators of potential future kidney failure.[11]

EPA REGULATION OF RADIONUCLIDES

The U.S. Environmental Protection Agency (EPA) regulates the following radionuclides: combined radium-226/228; (adjusted) gross alpha, beta particle, and photon radioactivity; and uranium.[12] The maximum contaminant level (MCL) for radium (combined 226/228) is 5 picocuries (a measurement of radioactivity) per liter of water (abbreviated as pCi/L). The MCL for uranium is 30 parts per billion (ppb), which was expected to result in reduced uranium exposures for 620,000 people.[13] The MCL for gross alpha particles is 15 pCi/L, not including radon and uranium.[14] The beta/photon emitters have an MCL of 4 millirems (a measure of absorbed radiation dose) per year (abbreviated as mrem/yr), which can be calculated based on a total of 168 beta particle and photon emitters.[15]

When the EPA issued its drinking water standards for radionuclides, the rule was expected to require fewer than 800 systems to install treatment.[16] The final rule was issued with three additional analytical methods for determining the concentration of radionuclides in drinking water.[17] The Standardized Monitoring Framework for radionuclides is complex. All entry points into the drinking water system (for example, each well that pumps water into the system) must be tested, and monitoring requirements are consistent with the monitoring requirements for other, comparable drinking water contaminants. States are not permitted to issue waivers for the radionuclide monitoring requirements.[18] However, states may waive the final two calendar quarters of initial monitoring for gross alpha, uranium, radium-226, and radium-228, if the sampling results from the previous two quarters are below the detection limit. Only systems that are vulnerable to beta/photon emitters must sample for gross beta, tritium, and strontium-90.[19]

ALL VIOLATIONS

In 2015, there were 2,297 violations of the Radionuclide Rule by 523 community water systems across the country. The systems in violation served 1,471,364 people.

Nationwide, the following states had the largest populations served by violating systems:

- Utah (243,999 people served)
- Wisconsin (197,230 people served)
- New Jersey (170,786 people served)
- Pennsylvania (169,648 people served)
- Arizona (78,468 people served)

When ranked by percentage of population served by community water systems with violations of the Radionuclide Rule, Utah ranked the highest, with 8.1 percent of its population served by systems with violations.[a]

HEALTH-BASED VIOLATIONS

In 2015, there were 962 health-based violations of the Radionuclide Rule by 258 community water systems across the country. The systems in violation served 445,969 people.

Nationally, these states had the highest populations served by violating systems:

- Wisconsin (117,117 people served)
- Texas (58,881 people served)
- California (57,834 people served)
- Iowa (50,230 people served)
- Illinois (45,555 people served)

When ranked by percentage of population served by community water systems with violations of the Radionuclide Rule, Wisconsin ranked the highest, with 2.0 percent of the population served by violating systems.[b]

ENFORCEMENT

Of the 2,297 reported violations of the Radionuclide Rule in 2015, formal enforcement action was taken by the EPA or the states in 11.7 percent of cases.[c] A little less than one-fifth of violations (434 violations) returned to compliance within the calendar year.

For health-based violations of the Radionuclide Rule, formal enforcement action was taken by the EPA or the states in 16.1 percent of the 962 violations reported in 2015.[d] Only about one in twenty health-based violations (5.82 percent; 56 violations) returned to compliance within the calendar year.

a In 2015, the estimated population of Utah was 2,995,919 people (from the Annual Estimates of the Resident Population for the United States, Regions, States, and Puerto Rico: April 1, 2010, to July 1, 2015 (NST-EST2015-01), U.S. Census Bureau, Population Division).

b In 2015, the estimated population of Wisconsin was 5,771,337 people (from the Annual Estimates of the Resident Population for the United States, Regions, States, and Puerto Rico: April 1, 2010, to July 1, 2015 (NST-EST2015-01), U.S. Census Bureau, Population Division).

c Formal enforcement action was taken for 268 violations out of the total 2,297 violations of the Radionuclide Rule in calendar year 2015. The federal government was responsible for 6.0 percent of formal enforcement actions (16 violations), and states were responsible for 94.0 percent (252 violations) of formal enforcement actions. Any enforcement action (including formal and informal actions) was taken in 88.6 percent of cases (2,036 actions for 2,247 violations).

d Formal enforcement action was taken for 155 health-based violations of the Radionuclide Rule in 2015. The federal government was responsible for 10.3 percent of formal enforcement actions (16 violations) and states were responsible for 89.7 percent (139 violations) of formal enforcement actions. Any enforcement action (including formal and informal actions) was taken in 95.2 percent of cases (916 violations).

FIGURE 11: 1.5 MILLION PEOPLE SERVED BY COMMUNITY WATER SYSTEMS WITH AT LEAST ONE REPORTED VIOLATION OF THE RADIONUCLIDE RULE (2015). POPULATIONS ARE SHADED AT THE COUNTY LEVEL TO SHOW THE NUMBER OF RESIDENTS SERVED BY COMMUNITY WATER SYSTEMS WITH VIOLATION(S) IN 2015.

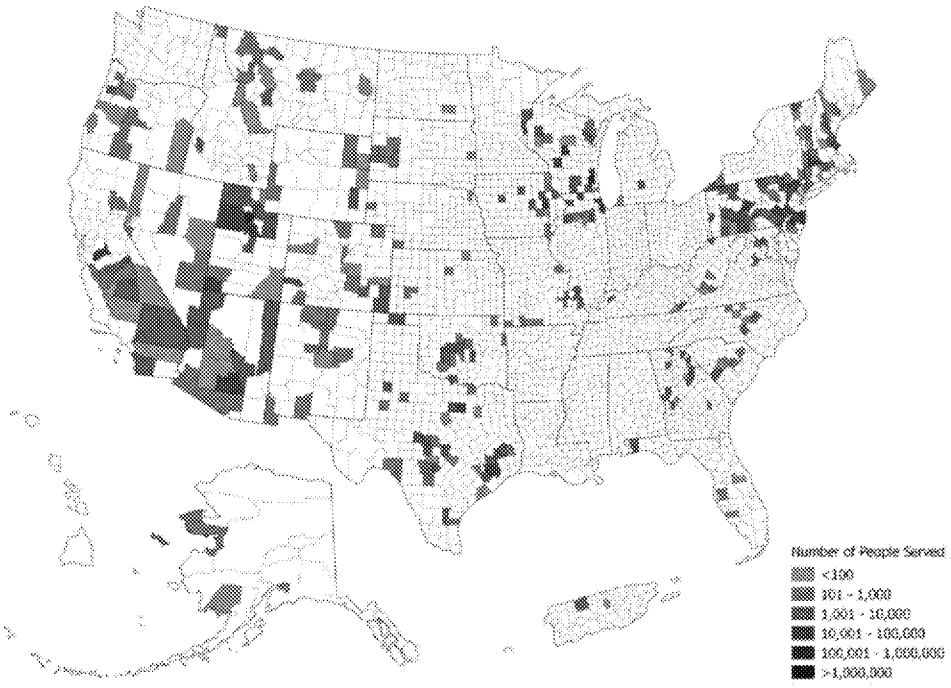
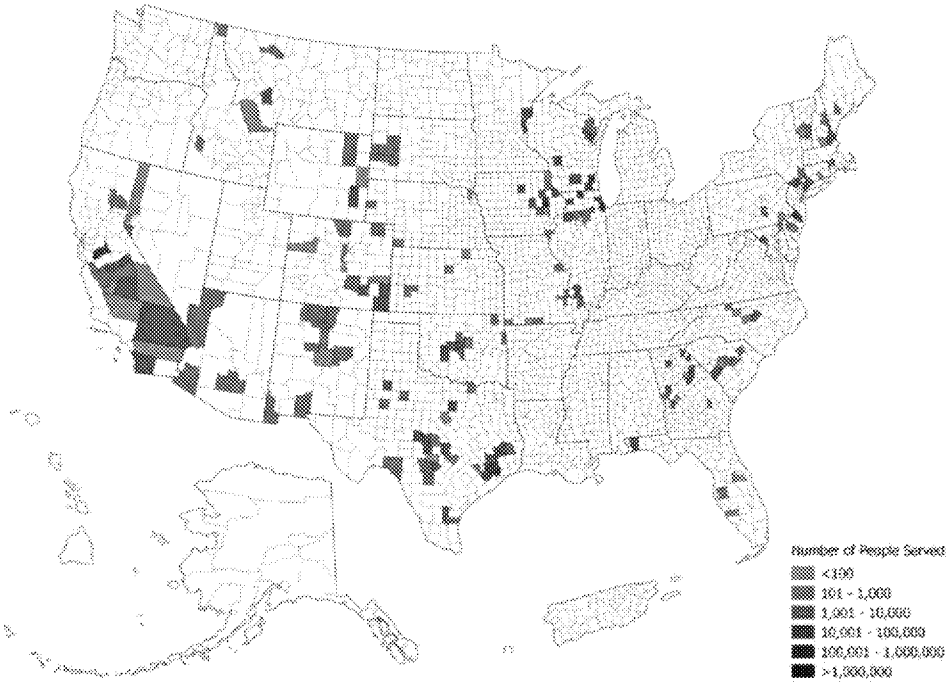


FIGURE 12: ALMOST 500,000 PEOPLE SERVED BY COMMUNITY WATER SYSTEMS WITH AT LEAST ONE REPORTED HEALTH-BASED VIOLATION OF THE RADIONUCLIDE RULE (2015). POPULATIONS ARE SHADED AT THE COUNTY LEVEL TO SHOW THE NUMBER OF RESIDENTS SERVED BY COMMUNITY WATER SYSTEMS WITH VIOLATION(S) IN 2015.



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Appendix 7: Arsenic

- Arsenic is one of a handful of chemicals that have been classified as a known human carcinogen.
- Exposure can lead to cancers, development effects, pulmonary disease, or cardiovascular disease.
- In 2015, there were 1,537 violations (1,135 of them health-based) at community water systems serving 1,842,594 people (358,323 health-based).
- Formal enforcement was taken in 28.9 percent of cases (37.1 percent of health-based cases).
- Less than one in eight of the violations (and about one in twenty health-based violations) returned to compliance within the calendar year.

BACKGROUND

Arsenic is a naturally occurring chemical, widely distributed in the earth's crust.[1] Arsenic is a metalloid, which has the properties of both a metal and a nonmetal.[2] It can be found in both organic and inorganic form.[3] It is typically found as an inorganic substance in the environment, combined with other elements such as oxygen, chlorine, and sulfur.[4] Arsenic compounds have no smell and no distinctive taste.[5] You cannot typically detect its presence in water without testing.

Arsenic can be released from both natural and human activity. Inorganic arsenic is used in wood preservative treatments, and before this decade it was widely used as a pesticide.[6] Because arsenic occurs naturally with many minerals, it is commonly exposed by mining operations, particularly from the smelting process, and can get into water as a result.[7] Arsenic may enter drinking water sources from wind-blown dust or from runoff and leaching.[8] Arsenic may also be released into the atmosphere from coal-fired power plants and incinerators.[9] Arsenic in these emissions can then travel through the air and end up in surface water or ground water by dissolving in rain or snow.[10]

HEALTH EFFECTS OF ARSENIC

Widespread, high concentrations of arsenic have been found contaminating the ground water in parts of the West, Southwest, Midwest, parts of Texas, and Northeast.[11] With long-term exposure, arsenic is a known human carcinogen and is reasonably anticipated to cause lung and bladder cancer, as well as cancer of the skin, kidney, nasal passages, liver, and prostate. Long-term ingestion of inorganic arsenic may also cause developmental effects, neurotoxicity, pulmonary disease, and cardiovascular disease.[12] Pigmentation changes in the skin and thickening of the skin may also occur with long-term exposure to high levels of inorganic arsenic. Immediate effects of acute (high level) arsenic poisoning include vomiting, abdominal pain, and diarrhea. This may be followed by numbness and tingling of the extremities, partial paralysis, blindness, and even death in extreme instances.[13] However, acute, extremely high-concentration arsenic poisoning from public water system drinking water in the United States has not been recently reported; lower-level contamination linked to cancer and other effects is considered the major health concern in the United States.

EPA REGULATION OF ARSENIC

Arsenic is regulated as one of the Inorganic Contaminants covered by the Safe Drinking Water Act. Currently, the U.S. Environmental Protection Agency (EPA) uses a maximum contaminant level (MCL) of 10 parts per billion (ppb) for arsenic.[14]

In 1942, the EPA set an interim MCL for arsenic in drinking water of 50 ppb as part of the National Interim Primary Drinking Water Standards.[15] In 1988, the agency conducted a risk assessment for arsenic in drinking water, finding adequate evidence to demonstrate that inorganic arsenic is a human carcinogen by the oral route.[16] In the 1996 amendments to the Safe Drinking Water Act (SDWA), Congress instructed the EPA to propose a new arsenic standard.[17] Accordingly, the EPA requested that the National Research Council (NRC), an arm of the National Academy of Sciences, conduct an independent review of arsenic in drinking water.[18] The resulting 1999 report, Arsenic in Drinking Water, concluded that "the current EPA MCL for arsenic in drinking water of 50 µg/L [ppb] does not achieve EPA's goal for public-health protection and, therefore, requires downward revision as promptly as possible."[19] The EPA proposed a new MCL of 5 ppb, but public health advocates pressed for a more protective standard of 3 ppb. Instead, in response to industry and political

pressure, the agency issued a weakened final MCL in January 2001, setting it at 10 ppb.[20] Even then, when President George W. Bush took office in 2001, he suspended the final rule.[21] An NRDC lawsuit challenging the suspension, a widespread public outcry, and another National Academy of Sciences study issued in September 2001 finding that the EPA had likely substantially underestimated the cancer risks,[22] successfully pushed the agency to ratify the final rule issued earlier that year that had set the MCL at 10 ppb.

Under the Standardized Monitoring Framework for inorganic chemical contaminants, such as arsenic, ground water systems are required to sample for arsenic once every three years.[23] Surface water systems must monitor for arsenic once a year. The final Arsenic Rule allows states to issue waivers for arsenic monitoring.[24] After a water system receives a waiver, it must take at least one sample during each nine-year waiver period. If a system's sample exceeds the MCL, then the system must collect samples quarterly until the system is consistently below the MCL.[25]

ALL VIOLATIONS

In 2015, there were 1,537 violations of the Arsenic Rule by 573 community water systems across the country. The systems in violation served 1,842,594 people. Nationwide, the states and territories with the highest populations served by violating systems were:

- Puerto Rico (1,064,755 people served)
- Arizona (241,020 people served)
- Texas (129,747 people served)
- California (105,804 people served)
- Pennsylvania (66, 591 people served)

When ranked by percentage of population served by community water systems with violations of the Arsenic Rule, Puerto Rico ranked the highest, with 30.1 percent of its population served by violating systems.[a]

HEALTH-BASED VIOLATIONS

In 2015, there were 1,135 health-based violations of the Arsenic Rule by 352 community water systems across the country. The systems in violation served 358,323 people. Nationally, these states and territories had the highest populations served by violating systems:

- Texas (124,535 people served)
- California (104,659 people served)
- New Mexico (34,732 people served)
- Tribal Lands in EPA Region 9 (14,002 people served)
- New Jersey (13,642 people served)

When ranked by percentage of population served by community water systems with violations of the Arsenic Rule, New Mexico ranked the highest, with 1.7 percent of the population served by violating systems.[b]

ENFORCEMENT

Of the 1,537 reported violations of the Arsenic Rule in 2015, formal enforcement action was taken by the EPA or the states in 28.9 percent of all cases.[c] A little more than one-eighth of the violations (208 violations) returned to compliance within the calendar year.

For health-based violations of the Arsenic Rule, formal enforcement action was taken by the EPA or the states in 37.1 percent of the 1,135 cases reported in 2015.[d] Only about one out of every twenty health-based violations (6.0 percent; 68 violations) returned to compliance within the calendar year.

a In 2015, the estimated population of Puerto Rico was 3,474,182 people (from the Annual Estimates of the Resident Population for the United States, Regions, States, and Puerto Rico: April 1, 2010, to July 1, 2015 (NST-EST2015-01), U.S. Census Bureau, Population Division).

b In 2015, the estimated population of New Mexico was 2,085,109 people (from the Annual Estimates of the Resident Population for the United States, Regions, States, and Puerto Rico: April 1, 2010, to July 1, 2015 (NST-EST2015-01), U.S. Census Bureau, Population Division).

c Formal enforcement action was taken for 444 violations out of the total 1,537 violations of the Arsenic Rule in calendar year 2015. The federal government was responsible for 7.2 percent of formal enforcement actions (32 violations), and states were responsible for 92.8 percent (412 violations). Any enforcement action (including formal and informal actions) was taken in 95.0 percent of cases (1,459 actions for 1,537 violations).

d Formal enforcement action was taken for 421 health-based violations of the Arsenic Rule in 2015. The federal government was responsible for 7.4 percent of formal enforcement actions (31 violations) and states were responsible for 92.6 percent (390 violations). Any enforcement action (including formal and informal actions) was taken in 95.1 percent of cases (1,079 violations).

FIGURE 7.1: 1.8 MILLION PEOPLE SERVED BY COMMUNITY WATER SYSTEMS WITH AT LEAST ONE REPORTED VIOLATION OF THE ARSENIC RULE IN 2015. POPULATIONS ARE SHADED AT THE COUNTY LEVEL TO SHOW THE NUMBER OF RESIDENTS SERVED BY COMMUNITY WATER SYSTEMS WITH VIOLATION(S) IN 2015.

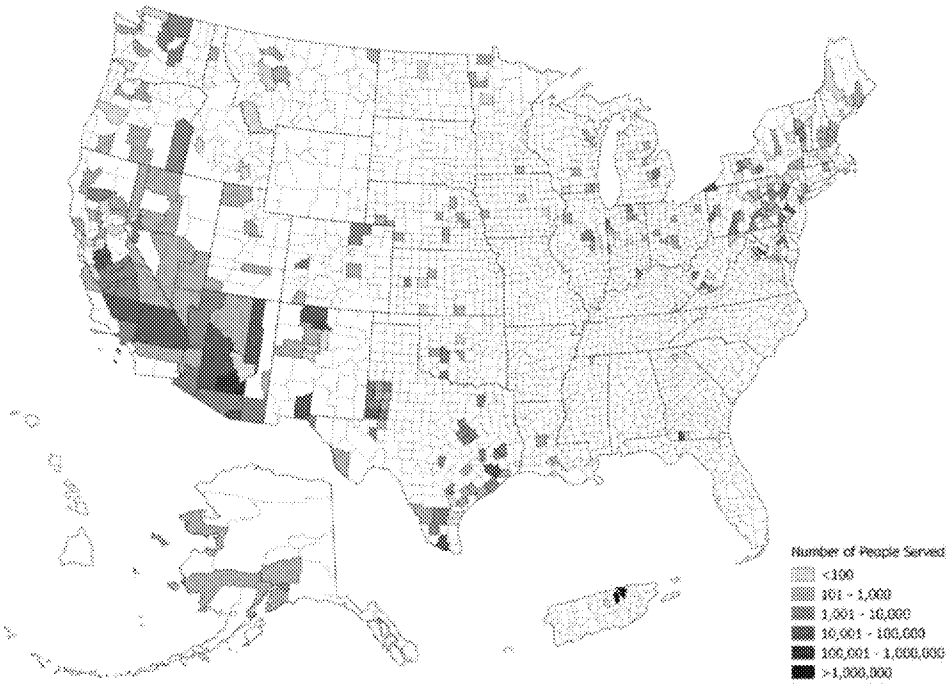
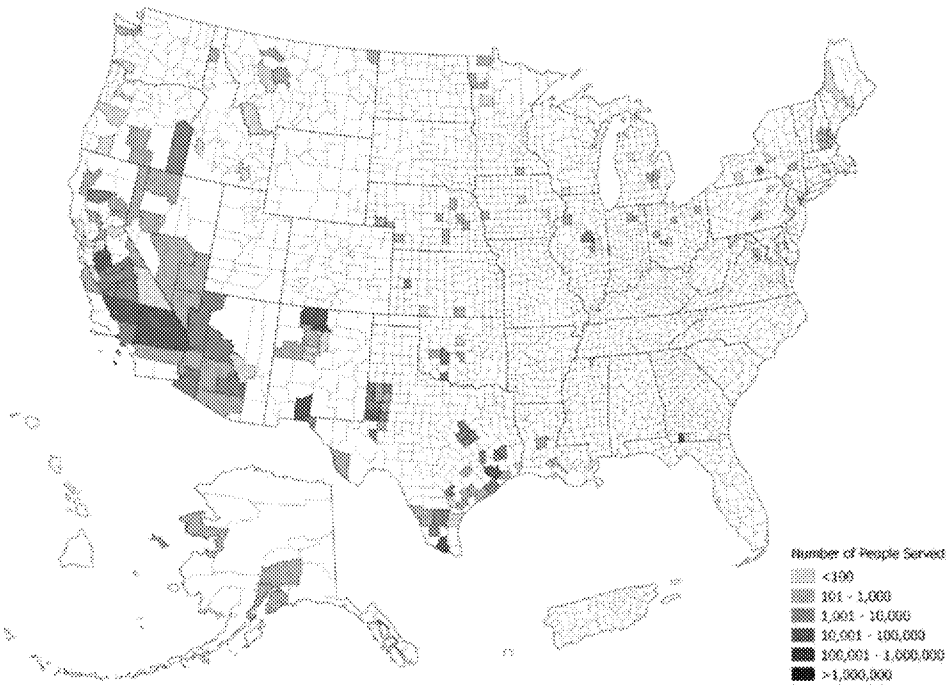


FIGURE 7.2: 350,000 PEOPLE SERVED BY COMMUNITY WATER SYSTEMS WITH AT LEAST ONE REPORTED HEALTH-BASED VIOLATION OF THE ARSENIC RULE IN 2015. POPULATIONS ARE SHADED AT THE COUNTY LEVEL TO SHOW THE NUMBER OF RESIDENTS SERVED BY COMMUNITY WATER SYSTEMS WITH VIOLATION(S) IN 2015.



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Appendix 8: Synthetic Organic Contaminants

- Exposure can lead to cancers, developmental effects, central nervous system and reproductive difficulties, endocrine issues, or liver and kidney problems.
- In 2015 there were 6,864 violations (17 health-based) serving 2,669,594 people (301,099 people for health-based).
- Formal enforcement action was taken in 7.3 percent of cases (and 5.9 percent of health-based cases).
- About one-third of all violations (and of health-based violations) returned to compliance within the calendar year.

BACKGROUND

In the mid-nineteenth century, we began to create chemicals that do not exist in nature.[1] This new chemistry expanded greatly during and after World War II. This led to the production of many synthetic organic chemicals (i.e., compounds that contain carbon) for use in a wide variety of products, from household cleaners, mothballs, and hair sprays to innumerable industrial, commercial, agricultural, and other products.[2] Synthetic organic compounds are used in pesticides, defoliants, plasticizers, wood preservatives, flame retardants, and solvents; they are also used as fuel additives and can occur as byproducts or waste materials from industrial processes.[3] Some synthetic chemicals cannot be detected through sight or smell, although others, like those found in coal tar, do have a distinctive odor.[4] The use of synthetic chemicals has greatly increased within the past 40 years to the point where they are pervasive in our daily lives.[5]

Synthetic organic chemicals (SOCs) now contaminate all parts of our environment, due to their widespread use and from spills and other discharges. They reach sources of drinking water through runoff and leachate from industrial and agricultural activities and landfills, via urban stormwater, and as byproducts of incineration.[6] Under certain soil and climatic conditions, SOCs may migrate into drinking water by runoff into surface water or by leaching into ground water.

HEALTH EFFECTS OF SYNTHETIC ORGANIC CONTAMINANTS

Many SOCs are toxic and can have substantial health impacts from both short-term and long-term exposure.[7] SOCs may cause health effects such as liver and kidney problems, can disrupt the endocrine (hormone-controlled) systems in the body, and can trigger central nervous system and reproductive difficulties as well as developmental defects.[8] Some are reasonably anticipated to increase the risk of certain kinds of cancers.[9] Atrazine, for example, is the one of the most commonly used pesticides in the United States. Atrazine has been shown in numerous studies to disrupt hormone activity in amphibians, particularly those exposed during early stages of development.[10] There is also evidence that links atrazine to cancer, and it has been banned from use in the European Union.[11,12] Between 1992 and 2001, atrazine and its metabolites were detected in more than 75 percent of stream samples and about 40 percent of shallow groundwater samples in agricultural areas across the United States.[13] In 2009, NRDC found that watersheds in the Midwest were pervasively contaminated with atrazine.[14] High levels of atrazine were also found in drinking water systems.

The herbicide 2,4-D (or 2,4-dichlorophenoxyacetic acid) is persistent in the environment and is detected in groundwater, surface water, and drinking water.[15] 2,4-D has been on the market since the mid-1940s as a cheap and effective weed killer.[16] It is used on food crops including fruits and vegetables, in forestry, and in urban and residential settings such as golf courses and lawns.[17] In 2015, the International Agency for Research on Cancer classified 2,4-D as possibly carcinogenic to humans.[18] Certain studies link 2,4-D with non-Hodgkin's lymphoma, a cancer of the body's immune cells.[19] Laboratory studies also suggest a link between 2,4-D and disruption of thyroid function, which is involved in brain development, growth, and immunity.[20]

EPA REGULATION OF SYNTHETIC ORGANIC CONTAMINANTS

As part of its Chemical Contaminants Rule, the Environmental Protection Agency (EPA) regulates SOCs in drinking water (see Table 1 for details).[21] Eighteen contaminant regulations were set in 1991, and another fifteen in 1992. These SOCs are primarily pesticides and industrial chemicals.[22]

All community water systems are initially required by the EPA to test each entry point to the distribution system (for example, at each well that pumps water into the water system) for SOCs for four consecutive quarters.[23] Subsequently, systems serving more than 3,300 people must sample two consecutive quarters every three years. Systems serving less than 3,301 people must submit a sample for each entry point once every three years.[24] This sampling may be avoided through waivers. If a water system detects a regulated SOC in drinking water, it must monitor quarterly to show that the contaminant in the drinking water is reliably and consistently below the MCL for three years.[25] Where a water system's tests indicate levels of an SOC higher than the MCL, the system must continue quarterly sampling, notify the Drinking Water Program, and work with the program to determine how the SOC is entering the drinking water supply.[26]

TABLE 8.1: SYNTHETIC ORGANIC CHEMICALS REGULATED BY THE U.S. ENVIRONMENTAL PROTECTION AGENCY

CHEMICAL	SOURCE	POTENTIAL HEALTH IMPACT	MCL (PPB)	MCLG (PPB)	NUMBER OF VIOLATIONS IN 2015[a]
2,3,7,8-TCDD (dioxin)	Emissions from waste incineration and other combustion; discharge from chemical factories	Reproductive difficulties; increased risk of cancer	0.00003	0	124
2,4,5-TP	Residue of banned herbicide	Liver problems	50	50	214
2,4-D	Runoff from herbicide used on row crops	Kidney, liver, or adrenal gland problems; possible cancer risk	70	70	232
Alachlor	Runoff from herbicide used on row crops	Eye, liver, kidney, or spleen problems; anemia; increased risk of cancer	2	0	0
Aldicarb	Runoff/leaching from pesticides	Nausea, diarrhea, and relatively minor neurological symptoms	3	1	32
Aldicarb sulfone	Runoff/leaching from pesticides	Nausea, diarrhea, and relatively minor neurological symptoms	2	1	32
Aldicarb sulfoxide	Runoff/leaching from pesticides	Nausea, diarrhea, and relatively minor neurological symptoms	4	1	32
Atrazine	Runoff from herbicide used on row crops	Cardiovascular system or reproductive problems; possible cancer risk	3	3	263
Benzo(a)pyrene	Leaching from linings of water storage tanks and distribution lines	Reproductive difficulties; increased risk of cancer	0.2	0	246
Carbofuran	Leaching of soil fumigant used on rice and alfalfa	Problems with blood, nervous system, or reproductive system	40	=40	255
Chlordane	Residue of banned termiticide	Liver or nervous system problems; increased risk of cancer	2	0	255
DBCP (1,2-dibromo-3-chloropropane)	Runoff/leaching from soil fumigant used on soybeans, cotton, pineapples, and orchards	Reproductive difficulties; increased risk of cancer	0.2	0	166
Dalapon	Runoff from herbicide used on rights-of-way	Minor kidney changes	200	200	213
Di(ethylhexyl)-adipate	Discharge from chemical factories	Weight loss, liver problems, possible reproductive difficulties	400	400	253
Di(ethylhexyl)-phthalate	Discharge from rubber and chemical factories	Reproductive difficulties; liver problems; increased risk of cancer	6	0	286
Dinoseb	Runoff from herbicide used on soybeans and vegetables	Reproductive difficulties	7	7	215
Diquat	Runoff from herbicide use	Cataracts	20	20	147

a Violations include all violations (both health-based and monitoring/reporting/other) violations for synthetic organic chemicals.

TABLE 8.1: SYNTHETIC ORGANIC CHEMICALS REGULATED BY THE U.S. ENVIRONMENTAL PROTECTION AGENCY					
CHEMICAL	SOURCE	POTENTIAL HEALTH IMPACT	MCL (PPB)	MCLG (PPB)	NUMBER OF VIOLATIONS IN 2015*
EDB (ethylene dibromide)	Discharge from petroleum refineries	Problems with liver, stomach, reproductive system, or kidneys; increased risk of cancer	0.05	0	177
Endothall	Runoff from herbicide use	Stomach and intestinal problems	100	100	150
Endrin	Residue of banned insecticide	Liver problems	2	2	230
Glyphosate	Runoff from herbicide use	Kidney problems; reproductive difficulties	700	700	150
Heptachlor	Residue of banned termiticide	Liver damage; increased risk of cancer	0.4	0	258
Heptachlor epoxide	Breakdown of heptachlor	Liver damage; increased risk of cancer	0.2	0	258
Hexachlorobenzene	Discharge from metal refineries and agricultural chemical factories	Liver or kidney problems; reproductive difficulties; increased risk of cancer	1	0	224
Hexachlorocyclopentadiene	Discharge from chemical factories	Kidney or stomach problems	50	50	269
Lindane	Runoff/leaching from insecticide used on cattle, lumber, gardens	Liver or kidney problems	0.2	0.2	0
Methoxychlor	Runoff/leaching from insecticide used on fruits, vegetables, alfalfa, livestock	Reproductive difficulties	40	40	257
Oxamyl	Runoff/leaching from insecticide used on apples, potatoes, and tomatoes	Slight nervous system effects	200	200	255
PCBs	Runoff from landfills; discharge of waste chemicals	Skin changes; thymus gland problems; immune deficiencies; reproductive or nervous system difficulties; increased risk of cancer	0.5	0	214
Pentachlorophenol	Discharge from wood preserving factories	Liver or kidney problems; increased cancer risk	1	0	220
Simazine	Herbicide runoff	Blood problems	4	4	255
Toxaphene	Runoff/leaching from insecticide used on cotton and cattle	Kidney, liver, or thyroid problems; increased risk of cancer	3	0	222

ALL VIOLATIONS

In 2015, there were 6,864 violations for synthetic organic chemicals by 311 community water systems across the country. The systems in violation served 2,669,594 people.

Nationwide, these states and territories had the highest populations served by violating systems:

- Puerto Rico (1,608,897 people served)
- Utah (254,573 people served)
- Pennsylvania (235,531 people served)
- New York (210,812 people served)
- Massachusetts (58,737 people)

When ranked by percentage of population served by community water systems with violations for synthetic organic chemicals, Puerto Rico ranked the highest with 46.3 percent of the population.[b]

HEALTH-BASED VIOLATIONS

In 2015, there were 17 health-based violations for synthetic organic chemicals by 13 community water systems across the country. The systems in violation served 301,099 people.

Nationally, only five states and territories had systems with health-based violations for synthetic organic chemicals. They were:

- Puerto Rico (219,329 people served)
- Florida (44,651 people served)
- Alabama (19,284 people served)
- California (13,883 people served)
- North Carolina (452 people served)[c]

Of the states/territories with health-based violations for synthetic organic chemicals, Puerto Rico had the highest percentage of its population (6.3 percent) served by violating systems.[d]

ENFORCEMENT

Of the 6,864 reported violations for synthetic organic chemicals in 2015, formal enforcement action was taken by the EPA or the states in 7.3 percent of cases.[e] A little more than one-third of all violations (2,373 violations) returned to compliance within the calendar year.

For health-based violations for synthetic organic chemicals, formal enforcement action was taken by the EPA or the states in 1 of the 17 violations reported in 2015.[f] Five health-based violations (29.4 percent) returned to compliance within the calendar year.

b In 2015, the estimated population of Puerto Rico was 3,474,182 people (from the Annual Estimates of the Resident Population for the United States, Regions, States, and Puerto Rico: April 1, 2010, to July 1, 2015 (NST-EST2015-01), U.S. Census Bureau, Population Division).

c An additional 11,556 people on tribal lands in EPA region 10 were served by systems with violations for synthetic organic chemicals.

d In 2015, the estimated population of Puerto Rico was 3,474,182 people (from the Annual Estimates of the Resident Population for the United States, Regions, States, and Puerto Rico: April 1, 2010, to July 1, 2015 (NST-EST2015-01), U.S. Census Bureau, Population Division).

e Formal enforcement action was taken for 504 violations out of the total 6,864 violations for synthetic organic chemicals in calendar year 2015 (January 1, 2015 to December 31, 2015). The federal government was responsible for 0 percent of formal enforcement actions (0 violations) and states were responsible for 100 percent (504 violations) of formal enforcement actions. Any enforcement action (including formal and informal actions) was taken in 81.0 percent (5,563 actions for 6,864 violations) of cases.

f Formal enforcement action was taken for 1 of the 17 health-based violations for synthetic organic chemicals in 2015. A state was responsible for 100 percent (1 violation) of formal enforcement actions. Any enforcement action (including formal and informal actions) was taken in 94.1 percent (16 violations) of cases.

FIGURE 8.1: 2.7 MILLION PEOPLE SERVED BY COMMUNITY WATER SYSTEMS WITH AT LEAST ONE REPORTED VIOLATION FOR SYNTHETIC ORGANIC CHEMICALS (2015). POPULATIONS ARE SHADED AT THE COUNTY LEVEL TO SHOW THE NUMBER OF RESIDENTS SERVED BY COMMUNITY WATER SYSTEMS WITH VIOLATION(S) IN 2015.

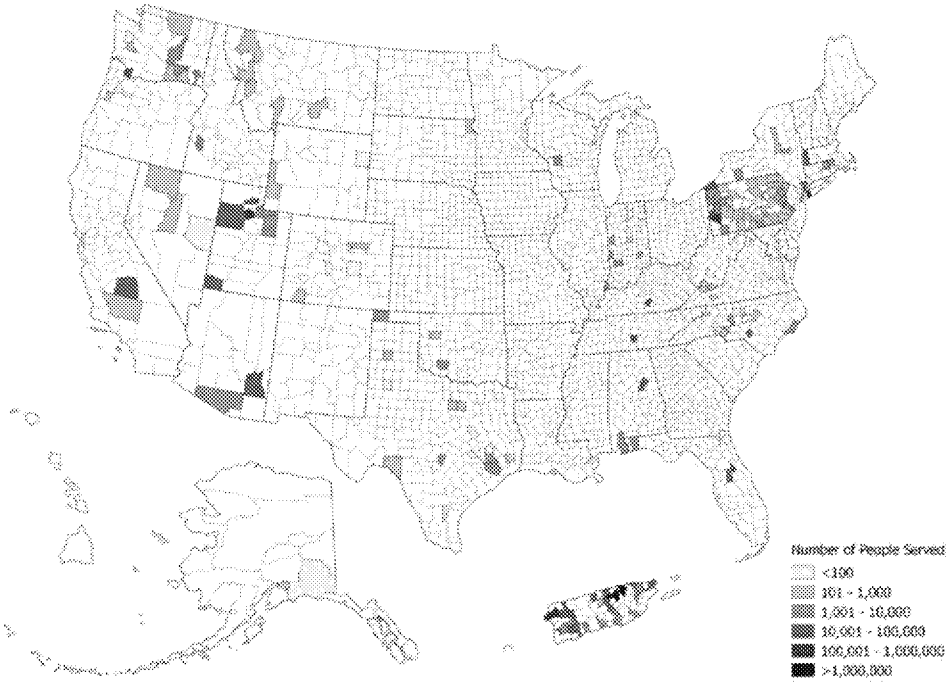
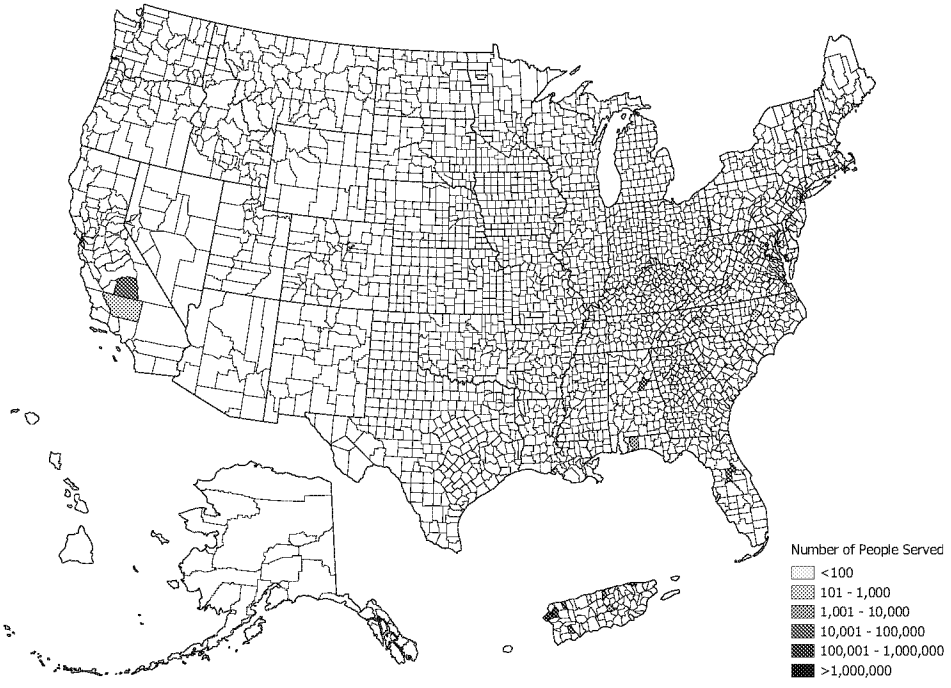


FIGURE 8.2: 300,000 PEOPLE SERVED BY COMMUNITY WATER SYSTEMS WITH AT LEAST ONE REPORTED HEALTH-BASED VIOLATION FOR SYNTHETIC ORGANIC CHEMICALS (2015). POPULATIONS ARE SHADED AT THE COUNTY LEVEL TO SHOW NUMBER OF RESIDENTS SERVED BY COMMUNITY WATER SYSTEMS WITH VIOLATION(S) IN 2015.



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Appendix 9: Inorganic Chemicals

- Health impacts vary by chemical and include increased cholesterol, kidney damage, hair loss, skin irritation, and cancer.
- In 2015 there were 1,505 violations (291 of them health-based) in community water systems serving 1,312,643 people (83,033 health-based).
- Formal enforcement was taken in 5.2 percent of cases (15.1 percent of health-based cases).
- Less than 1 out of 25 violations (and about 1 out of 100 health-based violations) returned to compliance within the calendar year.

BACKGROUND

Inorganic contaminants (IOCs) are materials of mineral origin.[1] The term inorganic describes substances such as salt, calcium salts, iron and other metals, as well as sand, and other mineral materials that don't contain carbon.[2] These materials are not easily digested or destroyed by microorganisms. Although there are many inorganic chemicals, the Environmental Protection Agency (EPA) has set maximum contaminant levels (MCLs) for 14 of them: asbestos, antimony, arsenic, barium, beryllium, cadmium, chromium, cyanide, fluoride, mercury, selenium, thallium, nitrate, and nitrite; the latter two are separately discussed in Appendix 4.[3] Lead and copper are also inorganic chemicals but are regulated under a treatment technique, as discussed in Appendix 5. (The EPA established a maximum contaminant level goal [MCLG], MCL, and monitoring requirements for nickel as well, but when the nickel industry challenged the standard in court in 1992, the agency agreed to withdraw and reconsider the MCLG and MCL. The monitoring requirements for nickel remain in place; the EPA has not yet issued a new nickel standard.[4])

Asbestos contamination of drinking water in Duluth, Minnesota, was one of the drinking water crises that triggered the enactment of the Safe Drinking Water Act in 1974.[5] Asbestos consists of a group of six different fibrous minerals that occur naturally in the environment.[6] Asbestos cement pipe was widely used for water mains in the past, but as these pipes age they are now often deteriorating and releasing asbestos into tap water.[7] Troublingly, the EPA's asbestos monitoring rules apply at the water treatment plant rather than at the tap. Asbestos that gets into the water supply from these pipes will not be detected, so there may be widespread asbestos exposure from tap water that is not being addressed. Commonly available products that may contain asbestos include brake linings, electrical breakers, pipe and sheet metals, tiles, wallboard, siding, and roofing.[8]

Cyanide, another inorganic chemical, is a familiar and fast-acting poison.[9] While it is often featured in murder mysteries and spy novels, it may be present in everyday products. Cyanide is a carbon-nitrogen chemical unit that combines with several other organic and inorganic compounds.[10] It is used in mining operations and can cause ground water or surface water contamination.[11] Hydrogen cyanide, cyanide's most commonly used form, is often enlisted to make the compounds needed for nylon and other synthetic fibers and resins. Other cyanides are used as herbicides.[12]

Mercury is released into the environment through combustion in coal-fired power plants, gold mining and processing, improper waste disposal, chemical manufacturing sites including old chloralkali plants, and natural sources such as volcanoes.[13] Other inorganic contaminants can find their way into water sources through discharge from petroleum refineries and other sources of industrial waste, mining and smelting operations, erosion of natural deposits, and through corrosion of galvanized pipes.[14]

HEALTH EFFECTS OF INORGANIC CONTAMINANTS AND EPA RULES

Some IOCs, if ingested, have adverse effects on respiratory, cardiovascular, dermal, developmental, neurological, musculoskeletal, gastrointestinal, renal, and reproductive systems.[15] Some IOCs are also reasonably anticipated to cause cancer in humans.[16] Mercury, for example, is a highly potent neurotoxin that affects the development and function of the central nervous system.[17] Exposure to mercury is especially concerning for pregnant and breastfeeding women, as well as children.[18] The age, gender, and health of the individual exposed will also impact the potential effects of exposure to IOCs. Fluoride is intentionally added to drinking water to help protect teeth from decay. But at excessive levels it can cause dental fluorosis (brown mottling of teeth) and in some people certain bone diseases, including skeletal fluorosis, and increased risk of bone fractures, according to a 2006 study by the National Academy of Sciences (which recommended that EPA tighten the fluoride standard).[19]

In 1991, EPA promulgated regulations for nine IOCs, including asbestos, fluoride, and mercury. The remaining five regulations for inorganic chemicals, including cyanide, were promulgated in 1992.[20]

Under EPA rules, water systems must sample for IOCs.[21] Under the Standardized Monitoring Framework for inorganic chemical contaminants, surface water systems monitor for inorganics annually (with the exception of nitrate/nitrite and asbestos), and ground water systems monitor every three years.[22] (See Table 9.1 for more details on regulated IOCs.) Where any of the regulated IOCs are detected at a concentration equal to or greater than the MCL, the water system must conduct quarterly monitoring for IOCs. Quarterly sampling must continue until the state determines that the analytical results are "reliably and consistently" below the MCL, or half the MCL for nitrate. Reduced monitoring programs and waivers are available at the state's discretion.[23]

TABLE 9.1: INORGANIC CHEMICALS REGULATED BY THE U.S. ENVIRONMENTAL PROTECTION AGENCY

CHEMICAL	SOURCE	POTENTIAL HEALTH IMPACT	MCL (PPB)	MCLG (PPB)	NUMBER OF VIOLATIONS IN 2015[a]
Antimony	Discharge from petroleum refineries, fire retardants, ceramics, electronics, solder	Increase in blood cholesterol, decrease in blood sugar	6	6	107
Asbestos	Decay of asbestos cement in water mains, erosion of natural deposits	Increased risk of developing benign intestinal polyps	7 million fibers per liter (MFL)	7 MFL	8
Barium	Discharge of drilling wastes, discharge from metal refineries, erosion of natural deposits	Increase in blood pressure	2,000	2,000	113
Beryllium	Discharge from textile finishing factories	Changes in adrenal glands	4	4	109
Cadmium	Corrosion of galvanized pipes, erosion of natural deposits, discharge from metal refineries, runoff from waste batteries and paints	Kidney damage	5	5	115
Chromium	Discharge from steel and pulp mills, erosion of natural deposits	Allergic dermatitis	100	100	108
Cyanide	Discharge from steel/metal factories, discharge from plastic and fertilizer factories	Nerve damage or thyroid problems	200	200	104
Fluoride	Water additive to promote strong teeth, erosion of natural deposits, discharge from fertilizer and aluminum factories	Bone disease (pain and tenderness of the bones, possible increased fracture risk from excess levels); mottled teeth in children	4,000	4,000	389
Mercury	Erosion of natural deposits, discharge from refineries and factories, runoff from landfills and croplands	Kidney damage	2	2	109
Nickel	Industry including transportation and chemical industries, electrical equipment, construction, natural deposits	Possible effects of chronic exposure include decreased body weight, heart and liver damage, dermatitis	[MCLG remanded by court]	[MCL remanded by court]	104
Selenium	Discharge from petroleum refineries, erosion of natural deposits, discharge from mines	Hair or fingernail loss, numbness in fingers or toes, circulatory problems	50	50	133
Thallium	Leaching from ore processing sites; discharge from electronics, glass, and drug factories	Hair loss; changes in blood; kidney, intestine, or liver problems	2	0.5	106

a Violations include all violations (both health-based and monitoring/reporting/other) for inorganic chemicals

ALL VIOLATIONS

In 2015, there were 1,505 violations for inorganic chemicals (excluding nitrates and nitrites) by 224 community water systems across the country. The systems in violation served 1,312,643 people.

Nationwide, these states and territories had the largest populations served by violating systems:

- Puerto Rico (1,068,453 people served)
- Pennsylvania (50,418 people served)
- Texas (46,401 people served)
- New Jersey (36,100 people served)
- California (18,443 people served)

When ranked by percentage of population served by community water systems with violations for inorganic chemicals (excluding nitrates and nitrites), Puerto Rico ranked the highest, with 30.8 percent of its population served by systems with violations.[b]

HEALTH-BASED VIOLATIONS

In 2015, there were 291 health-based violations for inorganic chemicals (excluding nitrates and nitrites) by 77 community water systems across the country. The systems in violation served 83,033 people.

Nationally, only 15 states reported health-based violations for inorganic chemicals (excluding nitrates and nitrites). Those with the highest populations served by violating systems were:

- Texas (41,456 people served)
- California (18,443 people served)
- Missouri (11,040 people served)
- New Mexico (4,676 people served)
- New York (2,800 people served)

When ranked by percentage of population served by community water systems with health-based violations for inorganic chemicals (excluding nitrates and nitrites), New Mexico ranked the highest with 0.22 percent of the population served by violating systems.c

ENFORCEMENT

Of the 1,505 reported violations for inorganic chemicals (excluding nitrates and nitrites) in 2015, formal enforcement action was taken by the EPA or the states in 5.2 percent of cases.[d] Only a little more than 1 out of every 25 violations (47 violations) returned to compliance within the calendar year.

For health-based violations for inorganic chemicals (excluding nitrates and nitrites), formal enforcement action was taken by EPA or the states in 15.1 percent of the 291 violations reported in 2015.[e] Only 1 percent (3 violations) returned to compliance within the calendar year.

b In 2015, the estimated population of Puerto Rico was 3,474,182 people (from the Annual Estimates of the Resident Population for the United States, Regions, States, and Puerto Rico: April 1, 2010, to July 1, 2015 (NST-EST2015-01). U.S. Census Bureau, Population Division).

c In 2015, the estimated population of New Mexico was 2,085,109 people (from the Annual Estimates of the Resident Population for the United States, Regions, States, and Puerto Rico: April 1, 2010, to July 1, 2015 (NST-EST2015-01). U.S. Census Bureau, Population Division).

d Formal enforcement action was taken for 78 violations out of the total 1,505 violations for inorganic chemicals (excluding nitrates and nitrites) in calendar year 2015. The federal government was responsible for 10.3 percent of formal enforcement actions (8 violations), and states were responsible for 89.7 percent (70 violations). Any enforcement action (including formal and informal actions) was taken in 94.0 percent of cases (1,415 actions for 1,505 violations) of cases.

e Formal enforcement action was taken for 44 health-based violations for inorganic chemicals (excluding nitrates and nitrites) in 2015. The federal government was responsible for 18.2 percent of formal enforcement actions (8 violations), and states were responsible for 81.8 percent (36 violations). Any enforcement action (including formal and informal actions) was taken in 97.6 percent of cases (284 violations) of cases.

FIGURE 9.1: 1.3 MILLION PEOPLE SERVED BY COMMUNITY WATER SYSTEMS WITH AT LEAST ONE REPORTED VIOLATION FOR INORGANIC CONTAMINANTS (EXCLUDING NITRATES AND NITRITES),2015. POPULATIONS ARE SHADED AT THE COUNTY LEVEL TO SHOW THE NUMBER OF RESIDENTS SERVED BY COMMUNITY WATER SYSTEMS WITH VIOLATION(S) IN 2015.

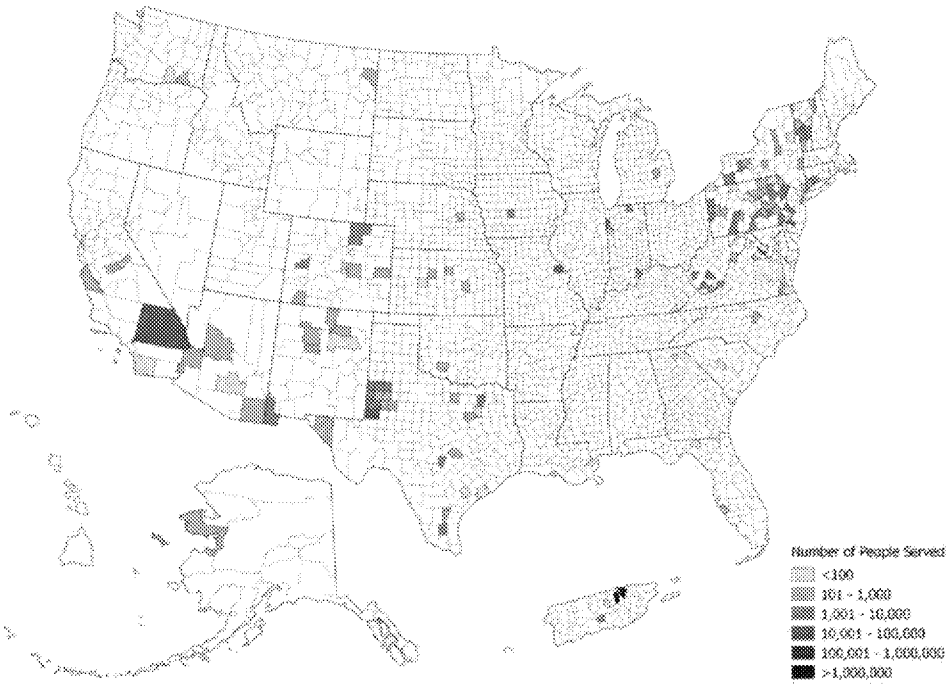
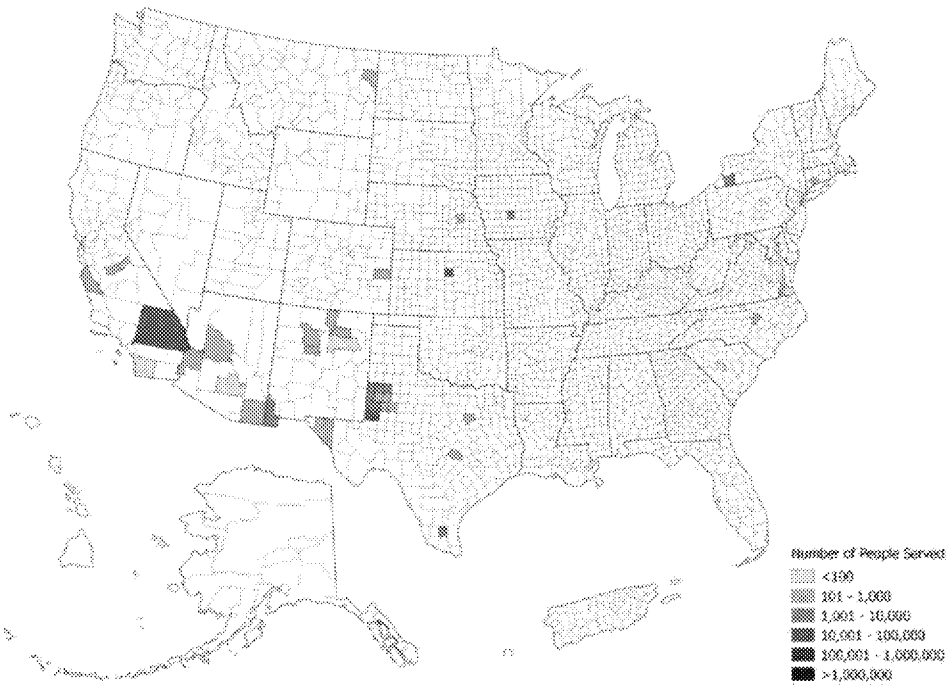


FIGURE 9.2: OVER 80,000 PEOPLE SERVED BY COMMUNITY WATER SYSTEMS WITH AT LEAST ONE REPORTED HEALTH-BASED VIOLATION FOR INORGANIC CONTAMINANTS (EXCLUDING NITRATES AND NITRITES), 2015. POPULATIONS ARE SHADED AT THE COUNTY LEVEL TO SHOW THE NUMBER OF RESIDENTS SERVED BY COMMUNITY WATER SYSTEMS WITH VIOLATION(S) IN 2015.



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2 Ibid.

3 40 CFR 141.62.; EPA, "Chemical Contaminant Rules," https://www.epa.gov/dwreginfo/chemical-contaminant-rules.

4 *See:* EPA, "Has EPA Promulgated a Maximum Contaminant Level (MCL) and Maximum Contaminant Level Goal (MCLG) for Nickel?" undated,https://safewater.zendesk.com/hc/en-us/articles/211404958-Has-EPA-promulgated-a-maximum-contaminant-level-MCL-and-maximum-contaminant-level-goal-MCLG-for-nickel-. *See also:* EPA, "National Primary Drinking Water Regulations: Nickel," October 1995, https://nepis.epa.gov/Exe/tiff2png.cgi/9100PO2K.PNG?-r+75+-g+7+D%3A%5CZYFILES%5CINDEX%20DATA%5C95THRU99%5CTIFF%5C00002435%5C9100PO2K.TIF.

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13 ATSDR, "Public Health Statement for Mercury," https://www.atsdr.cdc.gov/phs/phs.asp?id=112&tid=24.

14 Ibid.

15 ATSDR, http://www.atsdr.cdc.gov/, OEHHA, http://oehha.ca.gov/.

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17 ATSDR, "Public Health Statement for Mercury."

18 Ibid.

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20 40 CFR 141.62EPA, "Chemical Contaminant Rules."

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23 Ibid.

Appendix 10: Volatile Organic Contaminants

- Exposure can lead to cancers; developmental, skin, and reproductive issues; and cardiovascular problems. Exposure can also cause adverse effects on the liver, kidneys, and immune and nervous systems.
- In 2015 there were 10,383 violations (15 of them health-based) at community water systems serving 3,451,072 people (5,276 health-based).
- Formal enforcement was taken in 6.1 percent of cases (and 26.7 percent of health-based cases).
- Less than one in five of the violations (and a little more than one in twenty health-based violations) returned to compliance within the calendar year.

BACKGROUND

Volatile organic contaminants (VOCs) are gases at room temperature.[1] They can often be detected when products off-gas and produce an odor. For example, "new car smell" comes from VOCs that are released by the chemicals used in the interiors of cars.[2] VOCs are both man-made and naturally occurring compounds and are used for a variety of industrial and manufacturing purposes.[3] They are found in solvents, degreasers, and dry-cleaning chemicals and in personal care products such as fragrances, lubricants, paints, cleaners, and home furnishings.[4] VOCs are also used in the manufacture of rubber, pesticides, deodorants, and plastics.[5] The majority of VOCs found in water sources result from human activity.[6] When VOCs in liquid form are spilled or improperly disposed of by industrial users, a portion will evaporate, especially in surface water sources, but some can soak into the ground.[7] These pollutants are carried deeper underground by rainwater or snowmelt until they reach the groundwater table and can end up in drinking water supplies.[8]

For example, vinyl chloride is found in some well water and groundwater that supplies drinking water.[9] It gets into water supplies by leaching from hazardous waste sites, municipal landfills, and industrial facilities that make or use it in high quantities.[10] It goes into PVC plastics that are used for food and beverage containers and for other plastic products, including some water pipes. PVC water pipes, especially those made prior to 1977, can release vinyl chloride into tap water.[11] Vinyl chloride is regulated as a hazardous substance in drinking water, food, air, and consumer products and packaging.[12]

HEALTH EFFECTS OF VOLATILE ORGANIC CONTAMINANTS

Some VOCs have adverse effects on the liver, kidneys, immune, and nervous systems. Certain VOCs also cause skin, cardiovascular, developmental, and reproduction issues if ingested at certain levels.[13] Some are reasonably anticipated to cause cancer in humans.[14] The health impact of exposure to VOCs depends on the toxicity and concentration of the contaminant, as well as the duration of exposure to it. The age, gender, and health of the individual exposed will also impact the potential health effects of exposure to VOCs.

The U.S. Environmental Protection Agency (EPA) has determined that drinking water with 2 parts per billion (ppb) of vinyl chloride over an entire lifetime corresponds to an excess lifetime cancer risk of one in 10,000, which is considered to be highly significant.[15] Breathing vinyl chloride over many years can cause damage to the liver, kidney, and nervous system.[16]

Under EPA rules, water systems must sample for VOCs (see Table 10.1 for a list of regulated VOCs).[17] When the compounds are found, the source of the VOCs must be removed or treatment must be undertaken to reduce the amount of contaminant present. Water utilities are also required to alert customers if levels exceeded the maximum contaminant level (MCL).

EPA REGULATION OF VOLATILE ORGANIC CONTAMINANTS

In 1987, the EPA promulgated regulations for eight VOCs. It added ten more in 1991 and another three in 1992.[18] Many systems are also required to monitor for an additional seven VOCs as part of the Third Unregulated Contaminant Monitoring Rule.[19] These seven are not currently regulated, but the EPA uses the data to determine whether these chemicals occur in drinking water at levels of public health concern.

Monitoring requirements for VOCs depend on the type of source water and the detection of a contaminant. At entry points to the distribution system in water systems where none of the regulated VOCs are detected, the Standardized Monitoring Framework requires annual monitoring of regulated VOCs.[20] "Detection" under the framework is defined as 0.5 ppb for VOCs. Where any of the regulated VOCs are detected at a concentration equal to or greater than 0.5 ppb, the system must

conduct quarterly monitoring for VOCs.[21] Quarterly sampling must continue until the state determines that the analytical results are "reliably and consistently" below the MCL for two consecutive quarters in groundwater systems, and four consecutive quarters in surface water systems. For groundwater entry points to the distribution system, if no VOCs are detected during three consecutive years of annual monitoring, monitoring is reduced to once every three years. Systems may apply for a waiver after three years of no detections of VOCs.[22]

TABLE 10.1: VOLATILE ORGANIC CONTAMINANTS REGULATED BY THE U.S. ENVIRONMENTAL PROTECTION AGENCY

CHEMICAL	SOURCE	POTENTIAL HEALTH IMPACT	MCL (PPB)	MCLG (PPB)	NUMBER OF VIOLATIONS IN 2015*
1,1,1-Trichloroethane	Discharge from metal degreasing sites and other factories	Liver, nervous system, or circulatory problems	200	200	495
1,1,2-Trichloroethane	Discharge from industrial chemical factories	Liver, kidney, or immune system problems	5	3	494
1,1-Dichloroethylene	Discharge from industrial chemical factories	Increased risk of cancer	5	0	500
1,2,4-Trichlorobenzene	Discharge from textile finishing factories	Changes in adrenal glands	70	70	494
1,2-Dichloroethane	Discharge from industrial chemical factories	Increased risk of cancer	5	0	494
1,2-Dichloropropane	Discharge from industrial chemical factories	Increased risk of cancer	5	0	499
Benzene	Discharge from factories; leaching from gas storage tanks and landfills	Anemia; decrease in blood platelets; increased risk of cancer	5	0	516
Carbon tetrachloride	Discharge from chemical plants and other industrial activities	Liver problems; increased risk of cancer	5	0	500
Chlorobenzene	Discharge from chemical and agricultural chemical factories	Liver or kidney problems	100	100	497
cis-1,2-Dichloroethylene	Discharge from industrial chemical factories	Liver problems	70	70	495
Dichloromethane	Discharge from drug and chemical factories	Liver problems; increased risk of cancer	5	0	504
Ethylbenzene	Discharge from petroleum refineries	Liver or kidney problems	700	700	507
o-Dichlorobenzene	Discharge from industrial chemical factories	Liver, kidney, or circulatory system problems	600	600	496
p-Dichlorobenzene	Discharge from industrial chemical factories	Anemia; liver, kidney, or spleen damage; changes in blood	75	75	500
Styrene	Discharge from rubber and plastic factories; leaching from landfills	Liver, kidney, or circulatory system problems	100	100	496
Tetrachloroethylene	Discharge from factories and dry cleaners	Liver problems; increased risk of cancer	5	0	497
Toluene	Discharge from petroleum factories	Nervous system, kidney, or liver problems	10,00	10,00	510
trans-1,2-Dichloroethylene	Discharge from industrial chemical factories	Liver problems	100	100	496
Trichloroethylene	Discharge from metal degreasing sites and other factories	Liver problems; increased risk of cancer	5	0	497
Vinyl chloride	Leaching from PVC pipes; discharge from plastic factories	Increased risk of cancer	2	0	448
Xylenes, Total	Discharge from petroleum factories; discharge from chemical factories	Nervous system damage	10,000	10,000	448

ALL VIOLATIONS

In 2015, there were 10,383 violations for volatile organic chemicals by 406 community water systems across the country. The systems in violation served 3,451,072 people.

Nationwide, these states and territories had the largest populations served by violating systems:

- New Jersey (1,020,885 people served)
- Arizona (780,502 people served)
- Connecticut (422,213 people served)
- Washington (393,912 people served)
- Puerto Rico (196,248 people served)

When ranked by percentage of population served by community water systems with violations for volatile organic chemicals, Connecticut ranked the highest, with 11.8 percent of its population served by systems with violations.[a]

HEALTH-BASED VIOLATIONS

In 2015, there were 15 health-based violations for volatile organic chemicals by 6 community water systems across the country. The systems in violation served 5,276 people.

Nationally, only four states had reported health-based violations for volatile organic chemicals:

- Texas (2,308 people served)
- North Carolina (1,973 people served)
- Oklahoma (845 people served)
- Florida (150 people served)

When ranked by percentage of population served by community water systems with violations for volatile organic chemicals, Oklahoma ranked the highest of the four states, with 0.22 percent of its population served by violating systems.[b]

ENFORCEMENT

Of the 10,383 reported violations for volatile organic chemicals in 2015, formal enforcement action was taken by the EPA or the states in 6.1 percent of cases.[c] Less than one-fifth of all cases (1,937 violations) returned to compliance within the calendar year.

For health-based violations for volatile organic chemicals, formal enforcement action was taken by the EPA or the states in 26.7 percent of the 15 violations reported in 2015.[d] Only one out of the fifteen health-based violations (6.7 percent) returned to compliance within the calendar year.

a In 2015, the estimated population of Connecticut was 3,590,886 people (from the Annual Estimates of the Resident Population for the United States, Regions, States, and Puerto Rico: April 1, 2010, to July 1, 2015 (NST-EST2015-01). U.S. Census Bureau, Population Division).

b In 2015, the estimated population of Oklahoma was 3,911,338 people (from the Annual Estimates of the Resident Population for the United States, Regions, States, and Puerto Rico: April 1, 2010, to July 1, 2015 (NST-EST2015-01). U.S. Census Bureau, Population Division).

c Formal enforcement action was taken for 634 violations out of the total 10,383 violations for volatile organic chemicals in calendar year 2015. The federal government was responsible for 0 percent of formal enforcement actions (0 violations), and states were responsible for 100 percent (634 violations) of formal enforcement actions. Any enforcement action (including formal and informal actions) was taken in 83.7 percent of cases (8,686 actions for 10,383 violations).

d Formal enforcement action was taken for 4 health-based violations for volatile organic chemicals in 2015. The federal government was responsible for 0 percent of formal enforcement actions (0 violations), and states were responsible for 100 percent (4 violations) of formal enforcement actions. Any enforcement action (including formal and informal actions) was taken in 100 percent (15 violations) of cases.

FIGURE 10.1: 3.5 MILLION PEOPLE SERVED BY COMMUNITY WATER SYSTEMS WITH AT LEAST ONE REPORTED VIOLATION FOR VOLATILE ORGANIC CHEMICALS (2015). POPULATIONS ARE SHADED AT THE COUNTY LEVEL TO SHOW THE NUMBER OF RESIDENTS SERVED BY COMMUNITY WATER SYSTEMS WITH VIOLATION(S) IN 2015.

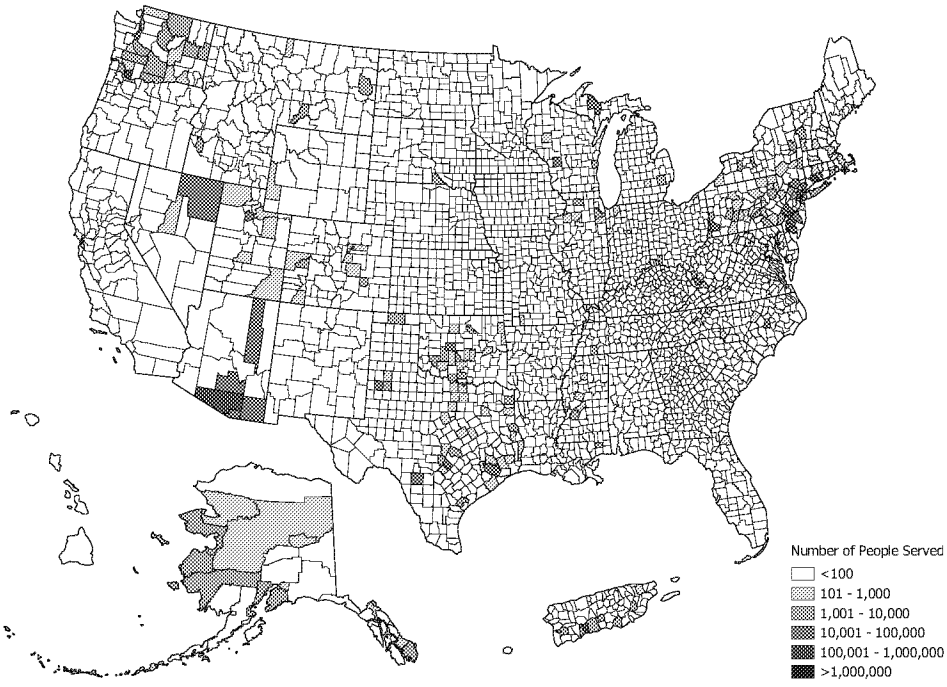
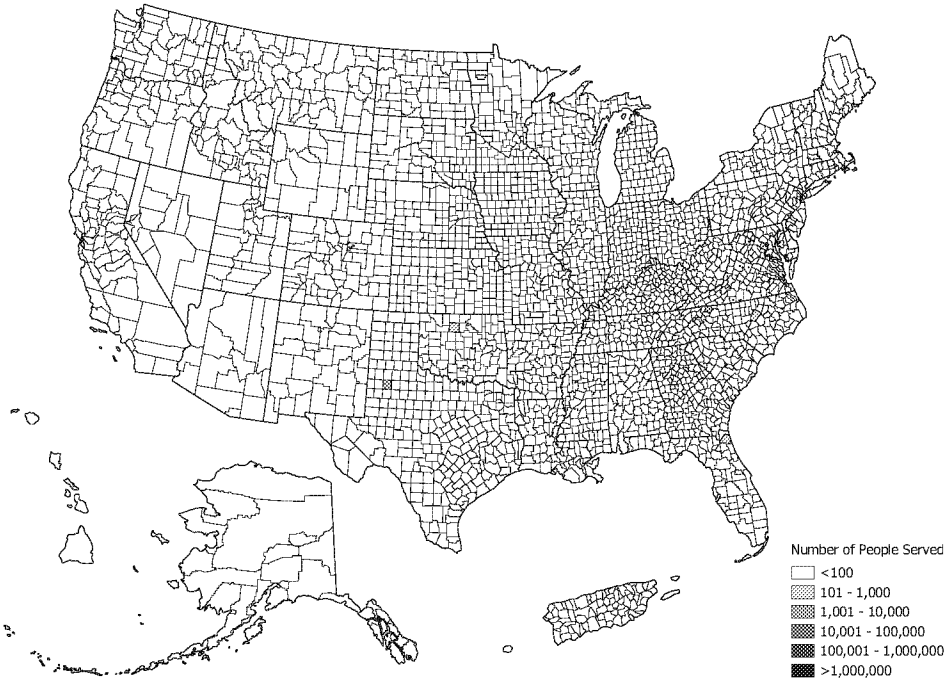


FIGURE 10.2: 5,000 PEOPLE SERVED BY COMMUNITY WATER SYSTEMS WITH AT LEAST ONE REPORTED HEALTH-BASED VIOLATION FOR VOLATILE ORGANIC CHEMICALS (2015). POPULATIONS ARE SHADED AT THE COUNTY LEVEL TO SHOW THE NUMBER OF RESIDENTS SERVED BY COMMUNITY WATER SYSTEMS WITH VIOLATION(S) IN 2015.



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15 EPA, "Toxicological Review of Vinyl Chloride," May 2000, https://cfpub.epa.gov/ncea/iris/iris_documents/documents/toxreviews/1001tr.pdf.

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17 40 CFR 141.61(able of Regulated Drinking Water Contaminants,"d Pipelines: Coal Tar Based Materials and Thier lth, ndar o Congres, Sept, 1993,a).

18 EPA, "Chemical Contaminant Rules," last updated April 2016, https://www.epa.gov/dwreginfo/chemical-contaminant-rules.

19 The third Unregulated Contaminant Monitoring Rule was published by the EPA on May 2, 2012, and required monitoring for 30 contaminants (28 chemicals and two viruses) between 2013 and 2015.

20 EPA, "Standardized Monitoring Framework: A Quick Reference Guide," March 2004. 40 CFR 141.61(a).

21 Ibid.

22 Ibid.

Appendix 11: Right-to-Know (or Consumer Confidence) Report Rule

- In 2015 there were 7,906 violations by community water systems serving 14,422,712 people.
- Formal enforcement action was taken in 10.3 percent of cases.
- Fewer than 1 in 3 of the violations returned to compliance within the calendar year.

EPA RULES

In order to help ensure that the public is informed about the quality of its tap water, the Safe Drinking Water Act (SDWA) Amendments of 1996 require all community water systems to directly deliver information about their drinking water quality to every customer once a year.[1] These annual right-to-know reports (called Consumer Confidence Reports, or CCRs, under the Act), are now often simply referred to as annual water quality reports. This requirement represented a landmark policy intended to provide important information to people served by systems regulated under the SDWA. Congress recognized that access to this information is critical to help consumers protect their health and to encourage participation in protecting drinking water sources. According to the SDWA, annual water quality reports must provide information on source water, the levels of detected contaminants, potential health effects of detected contaminants, and compliance with drinking water rules.[2] The reports are due to customers by July 1 of each calendar year.[3]

Distribution requirements under the Consumer Confidence Report Rule vary by the size of the water system. Systems serving 10,000 or more people must notify their customers by mail or direct delivery.[4] Systems serving fewer than 10,000 people may notify their customers by mail or direct delivery but also have the option of publishing the annual water quality report in a local newspaper in its entirety along with a statement that the report will not be mailed.[5] Systems serving fewer than 500 people can notify their customers by any of the methods described or simply inform consumers that the report is available upon request. Customers who do not receive a report can ask for one by calling their local water supplier, or they may find the report on the U.S. Environmental Protection Agency (EPA) website using a water quality report search tool.[6] Not all community water systems are required to post their reports on the website.[7]

The CCR Rule first took effectin 1998. As part of the EPA's review of regulations in 2011, the agency and stakeholders identified five areas in which the EPA could improve the water quality reports, including making them easier to understand and delivering them electronically. Under the EPA's current regulations, systems serving 100,000 or more consumers must post the current year's water quality report on a public website.[8] EPA has not updated this requirement since adopting it in 1998, despite the recommendations in the review.

ALL VIOLATIONS

In 2015 there were 7,906 violations of the Consumer Confidence Report Rule by 5,030 community water systems across the country. The systems in violation served 14,422,712 people.

Nationwide, the states with the largest populations served by violating systems were:

- Georgia (2,460,211 people served)
- Florida (2,451,439 people served)
- Washington (1,618,080 people served)
- Texas (1,099,791 people served)

Connecticut (1,074,594 people served)

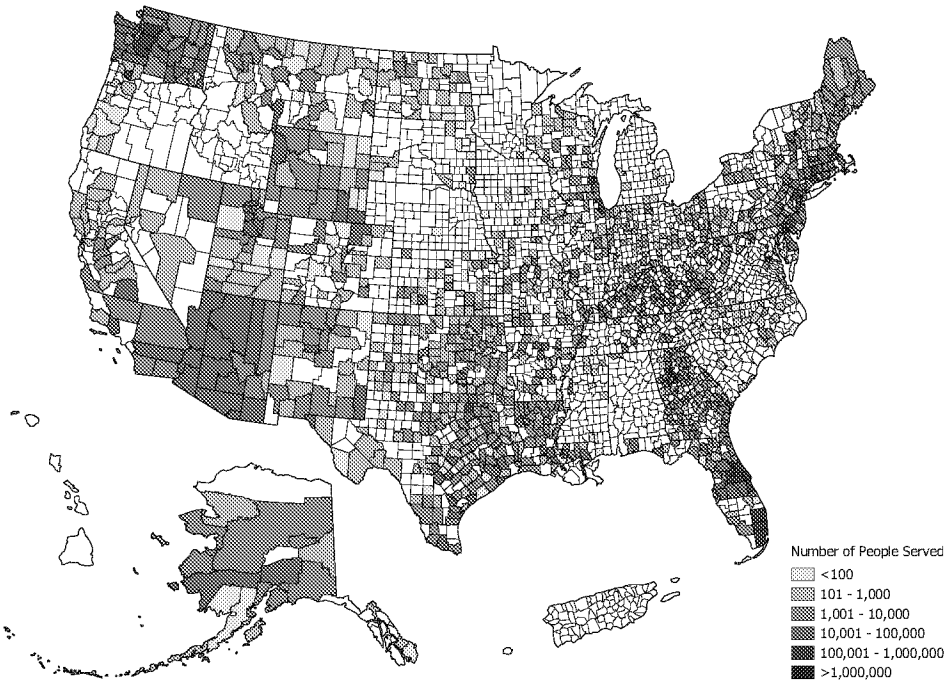
When ranked by percentage of population served by community water systems with violations of the Consumer Confidence Report Rule, Delaware ranked the highest, with 45.5 percent of its population served by violating systems.

ENFORCEMENT

Of the 7,906 reported violations of the Consumer Confidence Report Rule in 2015, formal enforcement action was taken by the EPA or the states in only 10.3 percent of cases.[a] Less than one-third of all cases (2,096 violations) returned to compliance within the calendar year.

a Formal enforcement action was taken for 813 violations out of the total 7,906 violations of the Consumer Confidence Report Rule in calendar year 2015. The federal government was responsible for 10.1 percent of formal enforcement actions (82 violations), and states were responsible for 89.9 percent (731 violations) of formal enforcement actions. Any enforcement action (including formal and informal actions) was taken in 81.6 percent of all cases (6,452 actions for 7,906 violations).

FIGURE 11.1: 14.4 MILLION PEOPLE SERVED BY COMMUNITY WATER SYSTEMS WITH AT LEAST ONE REPORTED VIOLATION OF THE CONSUMER CONFIDENCE REPORT (2015). POPULATIONS ARE SHADED AT THE COUNTY LEVEL TO SHOW THE NUMBER OF RESIDENTS SERVED BY COMMUNITY WATER SYSTEMS WITH VIOLATION(S) IN 2015.



ENDNOTES

1 40 CFR §141.151-155; Subpart Q.

2 40 CFR §141.151-155; Subpart Q.

3 Ibid.

4 40 CFR §141.204.

5 Ibid.

6 U.S. Environmental Protection Agency, "Safe Drinking Water Act: Consumer Confidence Reports (CCR)," last updated October 2016, https://www.epa.gov/ccr.

7 Ibid.

8 40 CFR CFR 257.107.

Appendix 12: Public Notification Rule

- The Public Notification Rule is intended to ensure that members of the public are swiftly informed if their water system has an acute violation of a drinking water rule that could threaten their health. It also is intended to let the public know about a violation that poses long-term or chronic health threats due to longer-term exposure to a contaminant, such as a carcinogen.
- In 2015 there were 13,202 violations at community water systems serving 8,381,050 people.
- Formal enforcement was taken in 26.9 percent of cases.
- About 1 in 7 violations returned to compliance within the calendar year.

EPA RULES

The U.S. Environmental Protection Agency (EPA) requires public water systems to notify their customers when they violate EPA drinking water regulations, or when they provide drinking water that may pose a risk to consumers' health.[1] These violations include the Safe Drinking Water Act's monitoring requirements. Under the Act, water systems are supposed to test for approximately 90 contaminants whose presence may pose a risk to human health.

In 2000 the EPA revised the original rule to require faster notice in emergencies and fewer notices overall, as well as to mandate clearer communication of potential health risks and information on how to avoid risks.[2] Under the Public Notification Rule, notices of a violation must contain 10 elements:

1. A description of the violation that occurred, including the contaminant(s) of concern and the contaminant level(s);
2. When the violation or situation occurred;
3. The potential health effects (including standard required language);
4. The population at risk, including subpopulations vulnerable if exposed to the contaminant in their drinking water;
5. Whether alternate water supplies need to be used;
6. What the water system is doing to correct the problem;
7. Actions consumers can take;
8. When the system expects a resolution to the problem;
9. How to contact the water system for more information; and
10. Language encouraging broader distribution of the notice.[3]

The Public Notification Rule contains three tiers of public notification, categorized by the seriousness of the impact on human health. Tier 1 rules apply in situations with a potentially immediate impact on human health. In such a situation, water suppliers must notify consumers within 24 hours. Tier 1 violations are:

1. *E. coli* maximum contaminant level (MCL) violations or failure to test for *E. coli* (Total Coliform Rule)
2. Nitrate/nitrite MCL violation or failure to take confirmation sample (Nitrate and Nitrite Rule)
3. Chlorine dioxide maximum residual disinfectant level (MRDL) violation or failure to take repeat sample (Disinfection Byproducts Rule)
4. Exceedance of maximum turbidity level, where the state determines Tier 1 is required (Surface Water Treatment Rules)
5. Nitrate exceedances for non-community water systems (NCWS) allowed to exceed standard (Nitrate and Nitrite Rule)
6. Waterborne disease outbreak or other waterborne emergency
7. Other situations determined by the primacy agency[4]

In response to a Tier 1 violation, water suppliers are required to use media outlets such as television, radio, and newspapers to notify the public, post their notice in public places, personally deliver a notice to their customers, or use an alternative method approved by the primacy agency.

Tier 2 rules apply when a system violates a rule with regard to the presence of a contaminant in a water system, but that violation does not pose an immediate risk to human health. In that case, the EPA requires the water system to notify its customers within 30 days of the violation. Tier 2 violations consist of:

All other MCL, MRDL, and treatment technique (TT) violations that are not Tier 1

1. Monitoring and testing procedure violations, where the state requires a Tier 2 (rather than Tier 3) notice
2. Failure to comply with variance and exemption conditions[5,6]

When a Tier 2 violation occurs, water systems are required to provide notice through the media, by posting, or by mail.

Under Tier 3, when a violation of SDWA regulations does not have a direct impact on human health, the water supplier has up to a year to provide notice to its customers. Tier 3 violations are:

1. All other monitoring or testing procedure violations not requiring a Tier 1 or Tier 2 notice
2. Operation under a variance or exemption
3. Special public notices:
    a. Exceedance of fluoride secondary maximum contaminant level (SMCL)[7]

Announcing the availability of unregulated monitoring results in response to Tier 3 violations, systems must also provide notice to consumers through the media, by posting, or by mail.[8]

ALL VIOLATIONS

In 2015, there were 13,202 violations of the Public Notification Rule by 3,394 community water systems across the country. The systems in violation served 8,381,050 people.

Nationwide, the states or territories with the largest populations served by violating systems were:

- Texas (2,894,089 people served)
- Wisconsin (1,894,967 people served)
- Kentucky (759,530 people served)
- Pennsylvania (631,923 people served)
- Florida (374,194 served)

When ranked by percentage of population served by community water systems with violations of the Public Notification Rule, Wisconsin ranked the highest, with 32.8 percent of its population served by violating systems.[a]

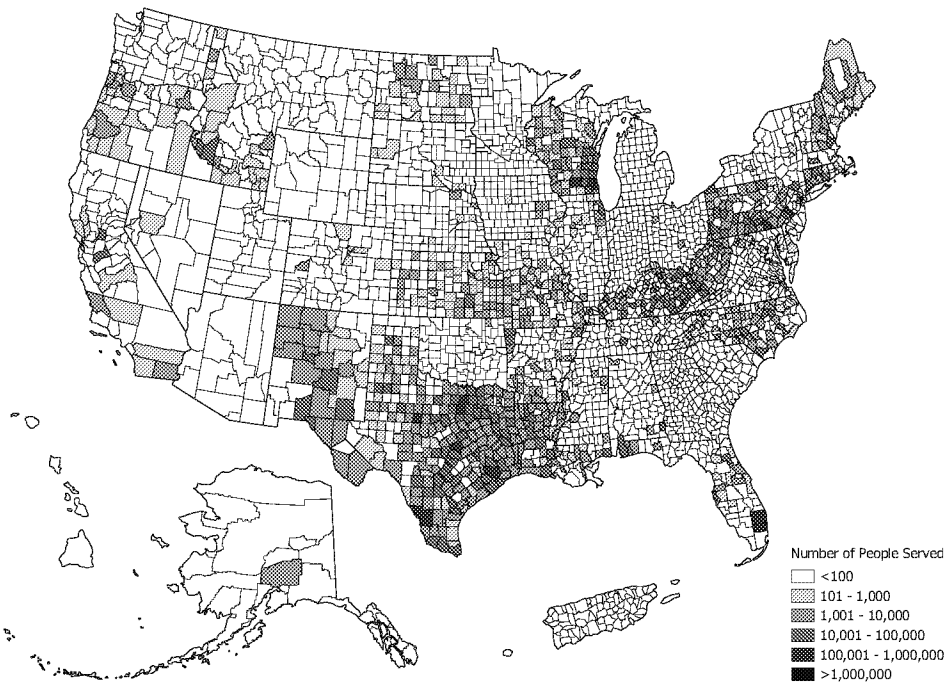
ENFORCEMENT

Of the 13,202 reported violations of the Public Notification Rule in 2015, formal enforcement action was taken by the EPA or the states in only 26.9 percent of cases.[b] About 1 in 7 violations (1,986 violations) returned to compliance within the calendar year.

a In 2015, the estimated population of Wisconsin was 5,771,337 people (from the Annual Estimates of the Resident Population for the United States, Regions, States, and Puerto Rico: April 1, 2010, to July 1, 2015 (NST-EST2015-01), U.S. Census Bureau, Population Division).

b Formal enforcement action was taken for 3,556 violations out of the total 13,202 violations of the Public Notification Rule in calendar year 2015. The federal government was responsible for 0.6 percent of formal enforcement actions (23 violations), and states were responsible for 99.4 percent (3,533 violations). Any enforcement action (including formal and informal actions) was taken in 82.7 percent of cases (10,915 actions for 13,202 violations).

FIGURE 12.1: 8.4 MILLION PEOPLE SERVED BY COMMUNITY WATER SYSTEMS WITH AT LEAST ONE REPORTED VIOLATION OF THE PUBLIC NOTIFICATION RULE (2015). POPULATIONS ARE SHADED AT THE COUNTY LEVEL TO SHOW THE NUMBER OF RESIDENTS SERVED BY COMMUNITY WATER SYSTEMS WITH VIOLATION(S) IN 2015.



ENDNOTES

1 40 CFR 141, Subpart Q

2 Ibid.

3 U.S. Environmental Protection Agency (hereinafter EPA), "Drinking Water Requirements for States and Public Water Systems: Public Notification Rule," https://www.epa.gov/dwreginfo/public-notification-rule#rule-summary

4 EPA, "Reporting, Forms and Instructions: Public Notification," https://www.epa.gov/region8-waterops/reporting-forms-and-instructions-public-notification.

5 Under SDWA, states or the EPA have the authority to grant variances and exemptions to help public water systems achieve compliance with MCLs. Variances permit eligible systems to provide drinking water that does not comply with a National Primary Drinking Water Regulation (NPDWR), provided that the system installs a certain technology and the quality of the drinking water remains protective of public health. Exemptions permit eligible systems additional time to achieve and maintain regulatory compliance with new NPDWRs, on the condition that they continue to provide acceptable levels of public health protection.

6 EPA, "Reporting, Forms and Instructions: Public Notification."

7 For some contaminants, the EPA establishes a secondary maximum contaminant level (SMCL) to manage drinking water for aesthetic or cosmetic effects under the Safe Drinking Water Act.

8 EPA, "Reporting, Forms and Instructions: Public Notification."

Message

From: DC-WJCE-2368T-M@epa.gov [DC-WJCE-2368T-M@epa.gov]
Sent: 3/19/2020 2:20:27 PM
To: Finn, Michael [Finn.Michael@epa.gov]
Attachments: image2020-03-19-102027.pdf

Message

From: DC-WJCE-2368T-M@epa.gov [DC-WJCE-2368T-M@epa.gov]
Sent: 3/19/2020 2:12:50 PM
To: Finn, Michael [Finn.Michael@epa.gov]
Attachments: image2020-03-19-101249.pdf

Message

From: DC-WJCE-2368T-M@epa.gov [DC-WJCE-2368T-M@epa.gov]
Sent: 3/19/2020 2:10:45 PM
To: Finn, Michael [Finn.Michael@epa.gov]
Attachments: image2020-03-19-101045.pdf

the surrounding communities should a serious interruption of water supply occur as examined and modeled in the DHS Exit 14 Study.

As discussed at the November 1, 2011 meeting, it is the City's understanding that, based upon clarification by the NJDEP, other alternative options may exist that would allow the entire Reservoir volume to be maintained, while still satisfying the requirements of the ACO. It is our understanding that because of the layout and configuration of the Cedar Grove Reservoir some of the items that resulted in the UV treatment option as not being considered cost effective may in fact be waived by the NJDEP, which may result in the UV treatment option being more cost-competitive when compared to covered storage. However, in order for the City to more effectively re-evaluate the UV treatment option, clarification and confirmation is needed from the NJDEP on the following issues:

1. The Cedar Grove Reservoir is an open impoundment and falls within a drainage area. While the reservoir is provided with drainage channels around its perimeter that capture and help in diverting runoff, it is recognized that there is runoff that enters the reservoir. If the NJDEP agrees that runoff into the reservoir is deminimus and acceptable in volume, then a concrete diversion wall will not be required.
2. The Water Department routinely samples the water leaving the Cedar Grove Reservoir and tests for Cryptosporidium, Giardia and viruses. This testing has been performed over the past nine (9) years. Copies of those tests results have been submitted to the NJDEP and EPA. During the nine (9) years of sampling and testing, all results for Cryptosporidium, Giardia and viruses were negative. This testing demonstrates that the finished water is high quality and that filtration of this supply is not warranted.
3. The Cedar Grove Reservoir is at a location and elevation where ground water intrusion should not be an issue and any ground water entering the reservoir when the Reservoir is full would be minimal. If the NJDEP agrees that the Cedar Grove Reservoir is not under the influence of ground water and any ground water entering the reservoir would be deminimus and acceptable in volume, then a reservoir liner with all appurtenances would not be required.
4. If the current full volume of the Cedar Grove Reservoir remains available, the City of Newark can continue to be an emergency supply of water for Newark and other users in North Jersey. This has been the case since the Cedar Grove Reservoir was constructed. If the clarifications requested results in a determination that the use of UV followed by chlorination will not suffice in satisfying the ACO, the City of Newark is left with no option other than the elimination of the Cedar Grove Reservoir and the construction of covered storage as recommended in the December 29, 2010 study submitted to NJDEP. If it is so desired by the State or the DHS to maintain a substantially larger volume of water at Cedar Grove for emergency purposes, the financial burden of providing any

additional storage, beyond that volume recommended in the HMM Study, would have to be borne by the other potential users or the State of New Jersey.

5. If the NJDEP is amenable to waiving the runoff issues noted above, and UV treatment is then found to be a cost-competitive alternative to covered storage, the plan would be to provide additional chlorine disinfection facilities following UV treatment in a similar fashion as the City has been doing for years. In addition, from the point of chorine application sufficient contact time shall exist before the first customer.
6. Should the NJDEP waive the need for runoff diversion and groundwater intrusion protection, what assurances will NJDEP provide to the City that the City will not be required to provide enhanced treatment (filtration or other treatment techniques) in the future should Cryptosporidium, Giardia or any viruses be found in the uncovered reservoir?
7. If NJDEP's review of the regulations is such that UV treatment followed by chlorination, and no modifications to Cedar Grove Reservoir, will not satisfy the requirements of the ACO, and the currently selected alternative of draining the Cedar Grove Reservoir and the construction of concrete storage tanks is selected, additional permit issues must be addressed. These permit issues are the water lowering permit and the storm water that will accumulate when the reservoir is drained and permanently empty. The City recently received a water lowering permit from the NJDEP Division of Fish and Wildlife while repairs were being performed to the Reservoir outlet piping. A permit requirement was to refill the reservoir by a specified date. It is not known if the NJDEP Division of Fish and Wildlife will issue a permit to permanently drain the Reservoir. Also when the reservoir is removed from service, the rainfall that would accumulate within the drained reservoir bottom must be handled and removed from the site. It is suspected that the volume of runoff that would accumulate will be substantial due to the impervious nature of the bed of the Reservoir.
8. The construction of either alternative, covered storage or UV treatment, will require approvals from the local municipalities, including, but not limited to, Little Falls, Cedar Grove and Montclair, where the construction would occur. It is believed that the ability to obtain the necessary permits and approvals will be a long and difficult process, probably delaying any compliance schedule that is ultimately developed and should be considered in the final ACO schedule.

If NJDEP is willing to waive the issues noted above, we would consider the following as a potential compliance schedule:

1. Amend Alternatives Evaluation Study
   (including internal reviews and review and approval by NJDEP) — Six (6) months
2. Solicit Technical Proposals and Development of Detailed Design — Eighteen (18)

months

3. Permitting, Local Approvals and NJEIT Financing	Twelve (12) months
4. Public Bidding and Contract Award	Six (6) months
5. Construction and Startup	Eighteen (18) months
Total time to satisfy the ACO	Sixty (60) months

We would appreciate receiving the NJDEP's comments on the issues outlined above. While attempting to preserve the maximum volume of water available for use it is mandatory that the City selects a long term solution that is not subject to future changes in interpretation or revised regulations and that satisfies the ACO in the most economical method possible.

If you have any questions or need additional information please contact Joseph Beckmeyer at 973-733-6303.

I look forward to hearing from you.

Sincerely,

Michael E. Greene, ESQ. Acting Director
Department of Water and Sewer Utilities

CC: Julien X. Neals ESQ. Business Administrator
Linda Watkins- Brashear, Executive Director NWCDC
Andrew Pappachen, Licensed Operator
Joseph Beckmeyer, PE Consultant
Paul Mourt PE Hatch Mott MacDonald

From: "Gray, Jason" <Jason.Gray@mail.house.gov>
To: Ed Walsh/DC/USEPA/US@EPA
Date: 04/24/2012 02:10 PM
Subject: Briefing on LT2 Treatment Rule

I just had a meeting on the compliance timeframes in the rule and I have a few questions for the drinking water program staff. Could we set up a meeting or a conf call to discuss. I understand the rule have a set of criteria for compliance with the 'reservoir cover' portion of the rule and a separate approach to compliance for the "treatment" portion of the rule. I need to better understand how each came to be and what the national outlook is for communities to comply with the rule.

Next week is recess so I'd likely be able to take the first available time. I will be out of the office on Thursday afternoon and all day Friday so those times are unavailable.

Thanks,
Jason

Jason Gray
House Committee on Appropriations
B-308 Rayburn
Washington, DC 20515
202.225.3081

Message

From: Finn, Michael [/O=EXCHANGELABS/OU=EXCHANGE ADMINISTRATIVE GROUP (FYDIBOHF23SPDLT)/CN=RECIPIENTS/CN=8D56E470F1EB406D94751DB70EF49687-MFINN]
Sent: 8/16/2017 7:50:15 PM
To: Souza, Emanuel [Souza.Emanuel@epa.gov]
Subject: MADEP West Newberry 332400
Attachments: MA3324000 WEST NEWBURY WATER DEPARTMENT.xlsx

Buddy
Attached is the data capture form.
The following data was not found
TTHM and HAA5 2014 all quarters, 2015 Q1.
RTCR sample plan

Mike Finn

Michael J Finn, P.E.
Drinking Water Protection Branch
Office of Groundwater and Drinking Water
U.S. Environmental Protection Agency
1200 Pennsylvania Ave NW
MC 4606M
Washington DC 20460

Room 2368P
202-564-5261
email:finn.michael@epa.gov

Message

From: Finn, Michael [/O=EXCHANGELABS/OU=EXCHANGE ADMINISTRATIVE GROUP (FYDIBOHF23SPDLT)/CN=RECIPIENTS/CN=8D56E470F1EB406D94751DB70EF49687-MFINN]
Sent: 8/30/2017 4:00:40 PM
To: Souza, Emanuel [Souza.Emanuel@epa.gov]
Subject: R1 File Review PWS ID 2158000 Littleton Water Department
Attachments: MA2158000 LITTLETON WATER DEPARTMENT.xlsx

Buddy
Attached is the data form for PWS ID#2158000
The following discrepancies were found
Spectacle Pond and TWF Whitcomb-2015 Nitrate not found
Whitcomb Well #1-2014 IOCs not complete
TCR-# samples per month reported does no match monitoring schedule, 21 samples required per state form, some months with less than 21, some months with more.
Stage 1-# of Chlorine residuals samples per month (10) does not meet requirements. # residual samples is to be the same as #TCR samples required.
I think this is all I owe.

Mike

Michael J Finn, P.E.
Drinking Water Protection Branch
Office of Groundwater and Drinking Water
U.S. Environmental Protection Agency
1200 Pennsylvania Ave NW
MC 4606M
Washington DC 20460

Room 2368P
202-564-5261
email:finn.michael@epa.gov

Message

From: Finn, Michael [/O=EXCHANGELABS/OU=EXCHANGE ADMINISTRATIVE GROUP (FYDIBOHF23SPDLT)/CN=RECIPIENTS/CN=8D56E470F1EB406D94751DB70EF49687-MFINN]
Sent: 8/29/2017 3:20:08 PM
To: Souza, Emanuel [Souza.Emanuel@epa.gov]
Subject: R1 File Review Cohasset Water Department PWS ID MA 406500
Attachments: MA4065000 COHASSET WATER DEPARTMENT .xlsx

Buddy
Attached is the review form for Cohasset Water Department
Summary of review
-Discrepancy in population served and # of service connections SDWIS FED/State Records
-Elm Meadows Well no 2016 Nitrate result found
-Stage 2 DBPR no 2014 or 2015 data found.
-Cohasset WTP and Elm Meadows Well -no 2014 or 2016 SOC data found, no information on SOC waivers

Mike Finn